500.37149X00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): S. MAEDA, et al

Serial No.: 09/294,137

Filed: April 20, 1999

For: DEFECT INSPECTION METHOD AND APPARATUS

Group:

Examiner:

TRANSMITTAL OF FORMAL DRAWING(S)

Assistant Commissioner for Patents
Washington, D.C. 20231

June 24, 1999

Sir:

Enclosed are thirty-nine (39) sheets of formal drawing(s), showing Figs. 1-12, 13A-13C, 14A-14B, 15A-15B, 16A-16B, 17A-17B, 18A-18B, 19-39, 40A-40B, 41-42, 43A-43B, 44A-44C and 45-46, in connection with the above-identified application.

Respectfully submitted,

Melvin Kraus
Registration No. 22,466
ANTONELLI, TERRY, STOUT & KRAUS, LLP

MK/cee
Attachments
(703) 312-6600

FIG. 1

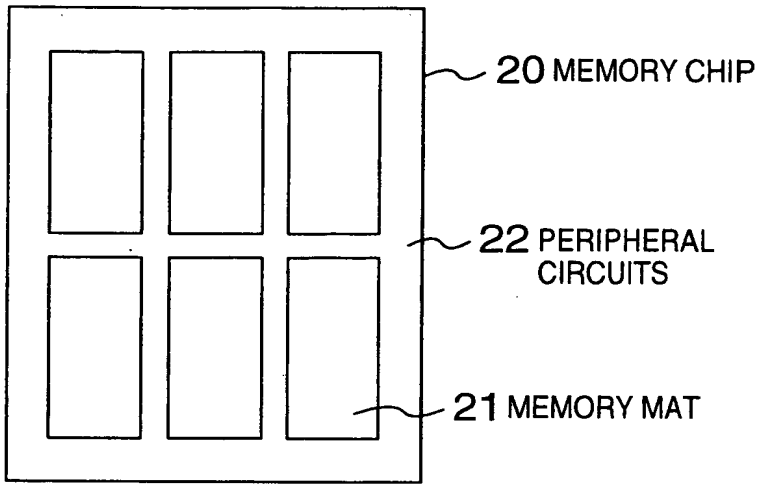


FIG. 2

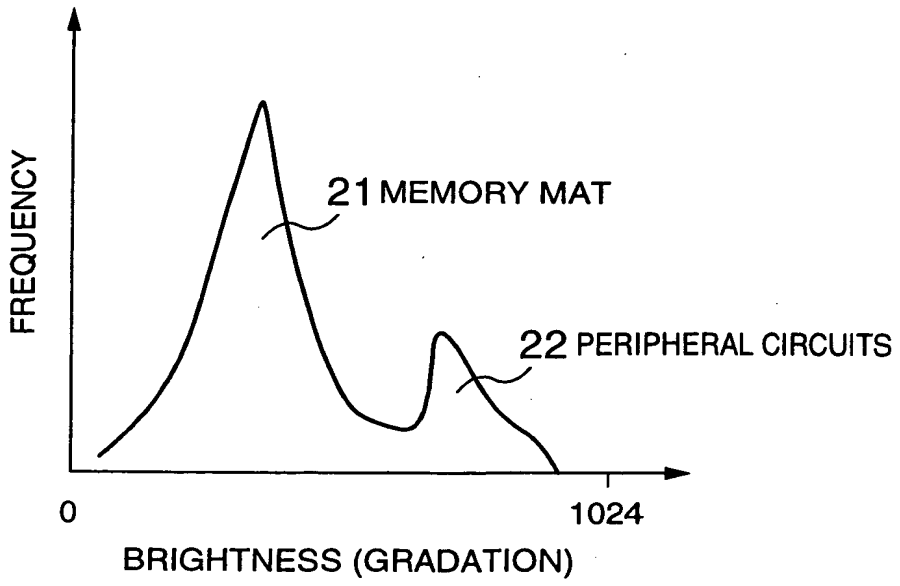


FIG. 3

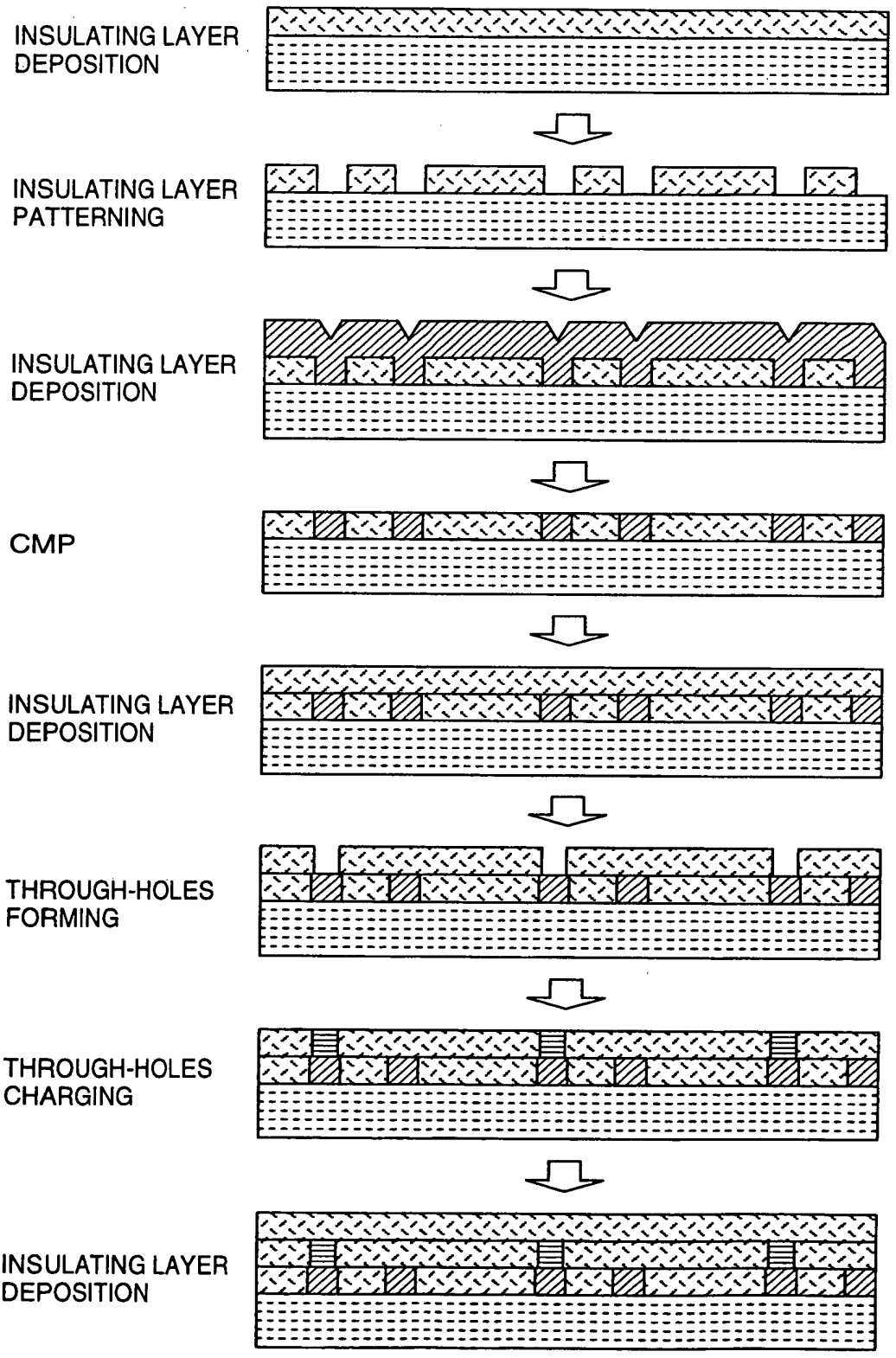


FIG. 4

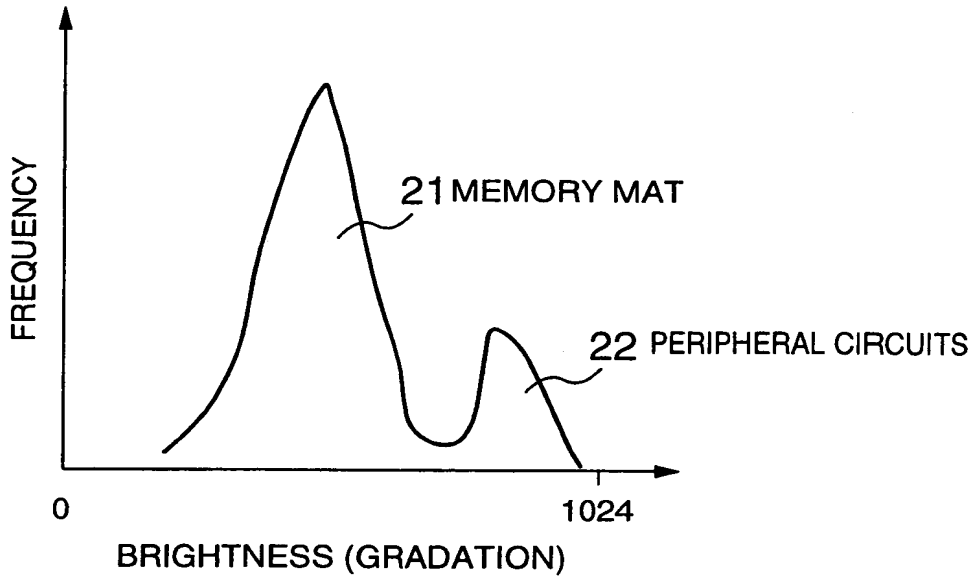


FIG. 5

	−1	0	1
−1	8.28×10^{11}	1.56×10^{11}	9.07×10^{11}
0	8.55×10^{11}	0	8.59×10^{11}
1	9.0×10^{11}	1.55×10^{11}	8.33×10^{11}

FIG. 6

	−1	0	1
−1	967323	742941	951727
0	953922	732608	939418
1	950797	728523	937704

FIG. 7

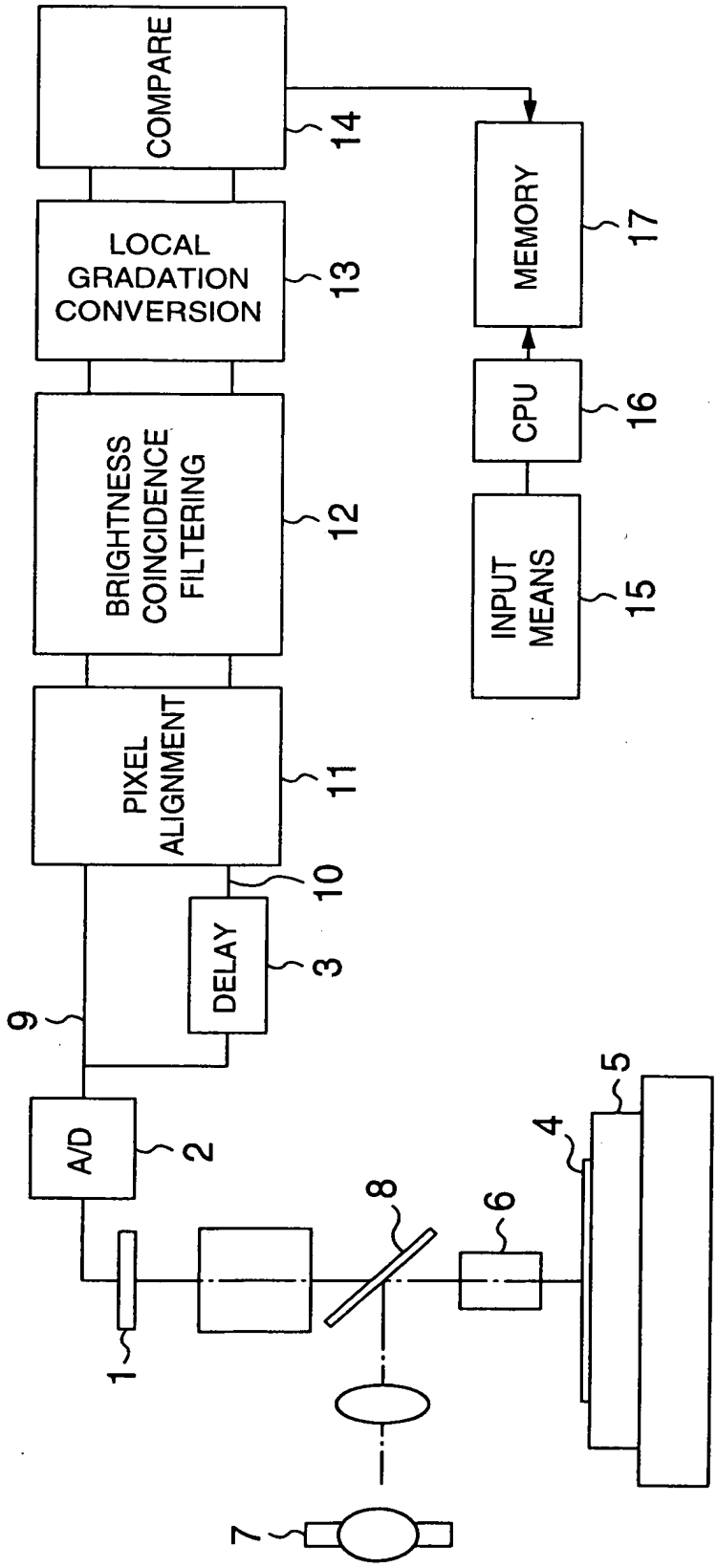


FIG. 8

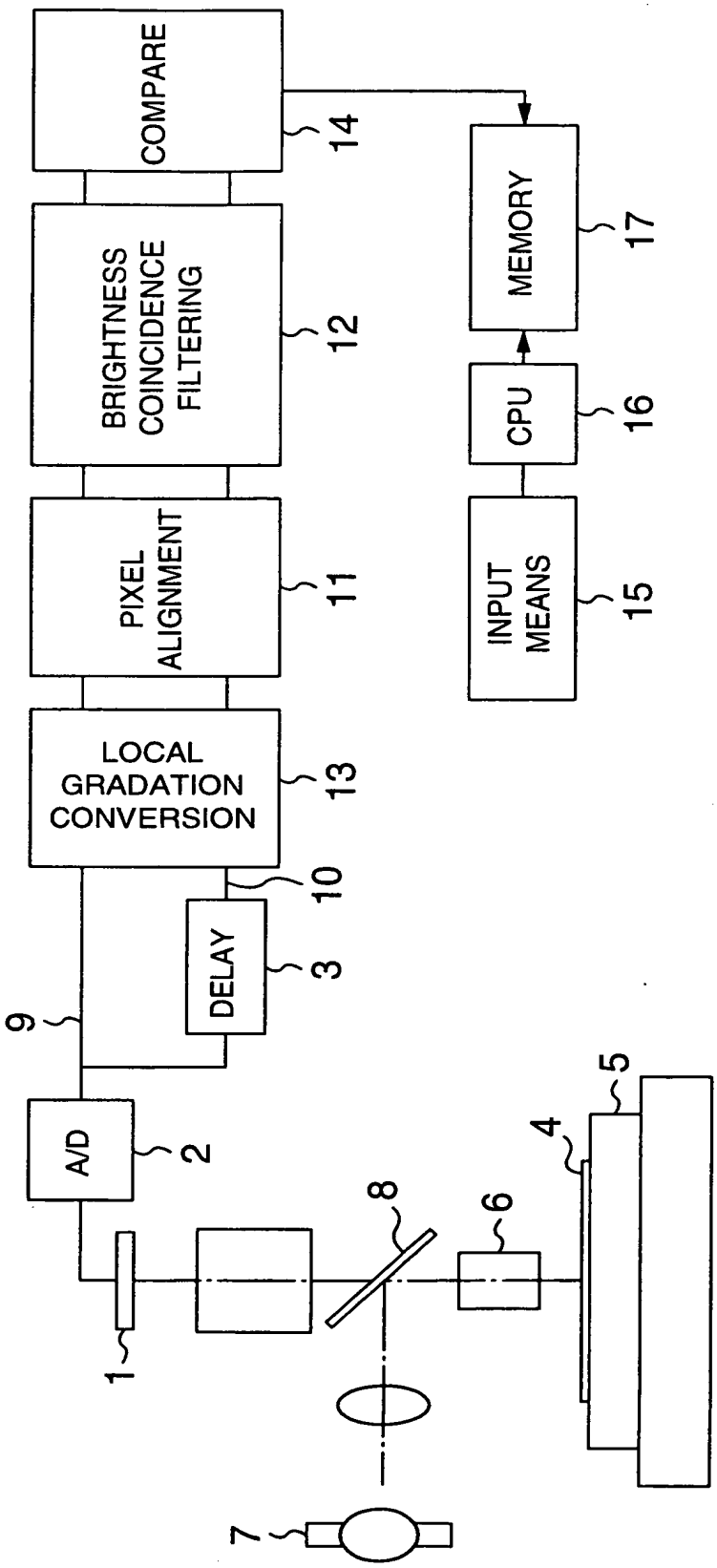


FIG. 9

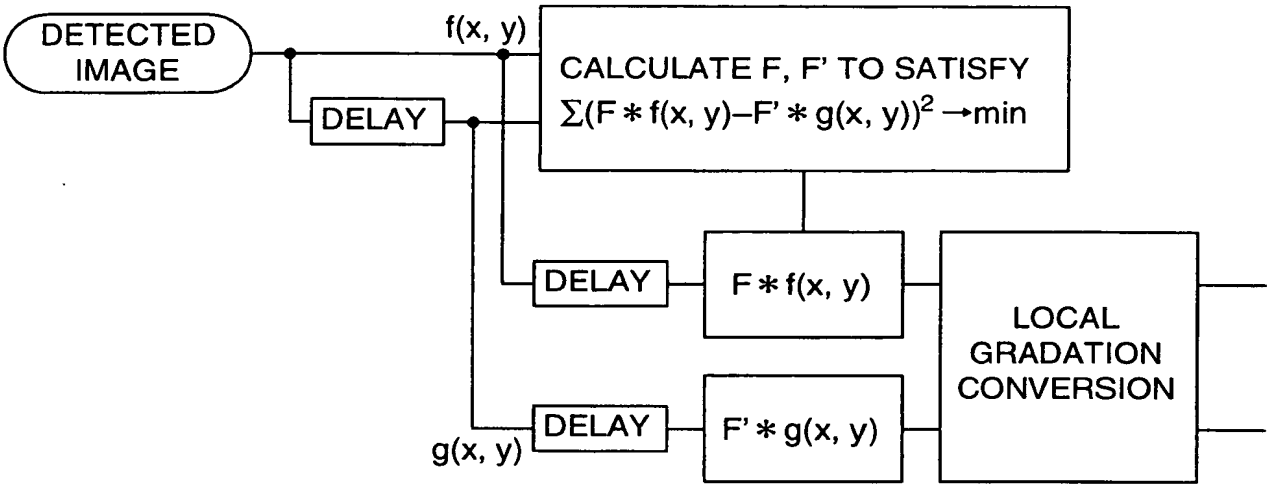


FIG. 10

$$F = \begin{pmatrix} 1-\alpha-\beta & \alpha \\ \beta & 0 \end{pmatrix}$$

$$F' = \begin{pmatrix} 0 & \beta \\ \alpha & 1-\alpha-\beta \end{pmatrix}$$

FIG. 11

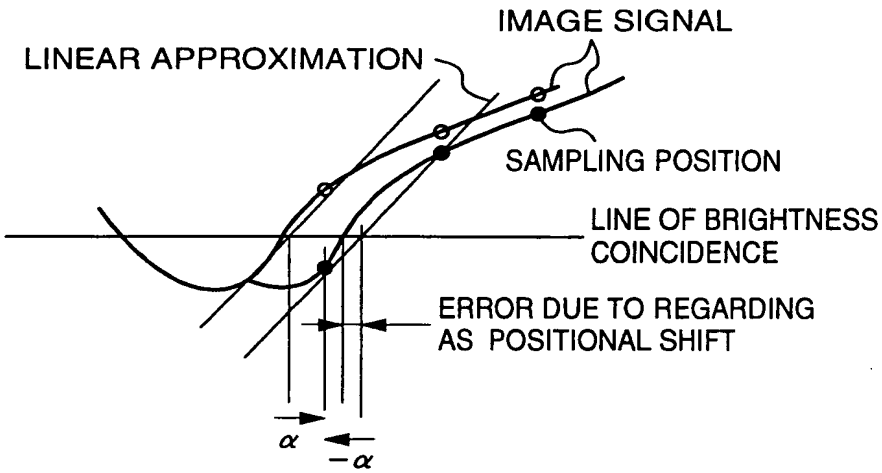
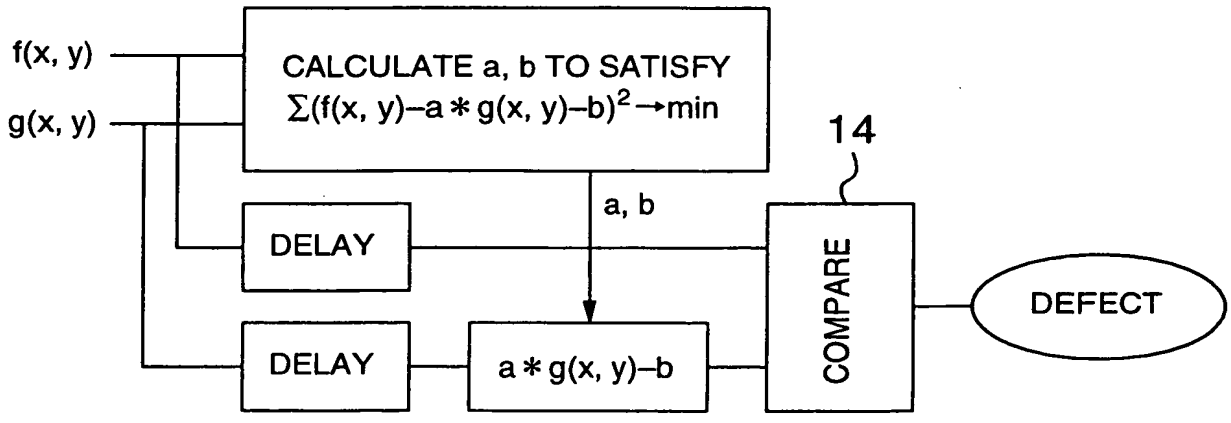


FIG. 12



f(x, y)

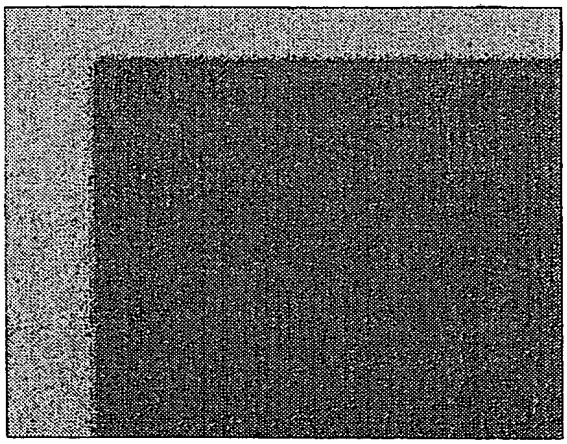


FIG. 13A

g(x, y)

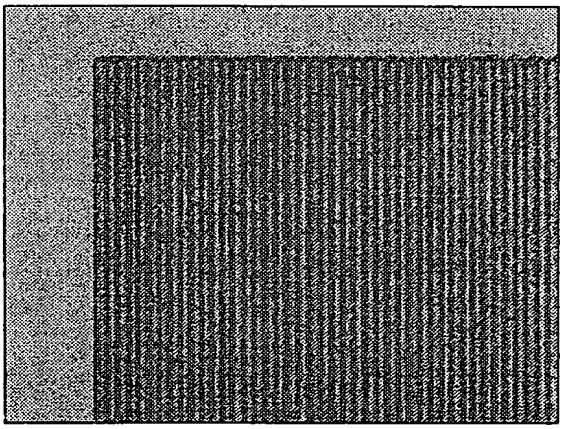
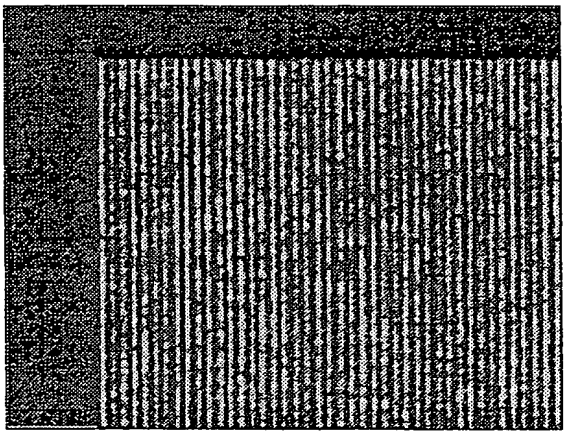


FIG. 13B

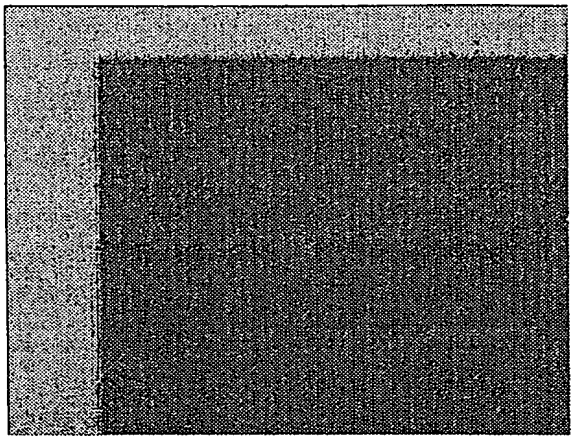
| f(x, y)–g(x, y) |



DIFFERENCE IMAGE

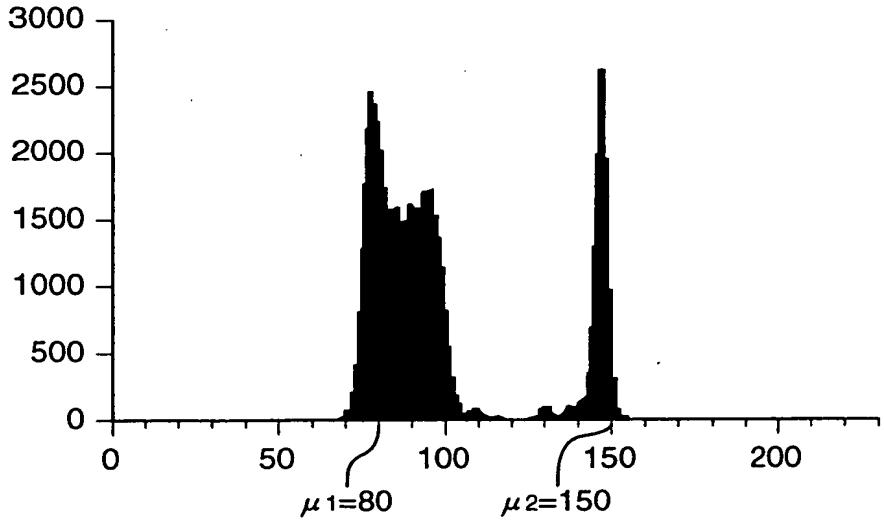
FIG. 13C

FIG. 14A



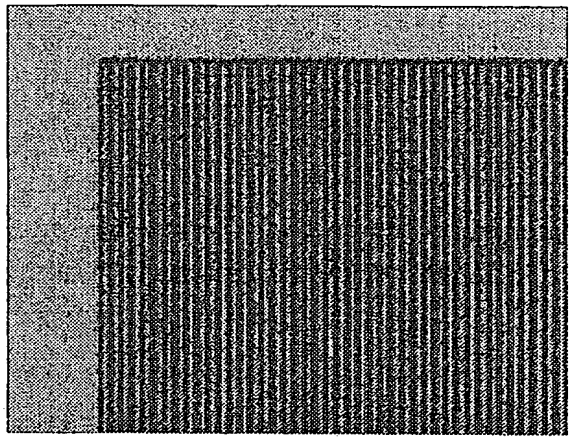
g(x, y)

FIG. 14B



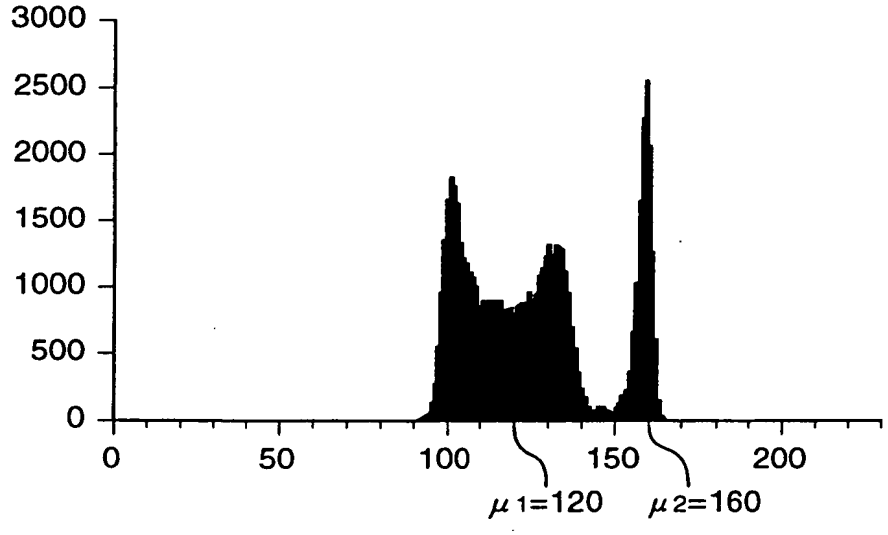
BRIGHTNESS HISTOGRAM OF g(x, y)

FIG. 15A



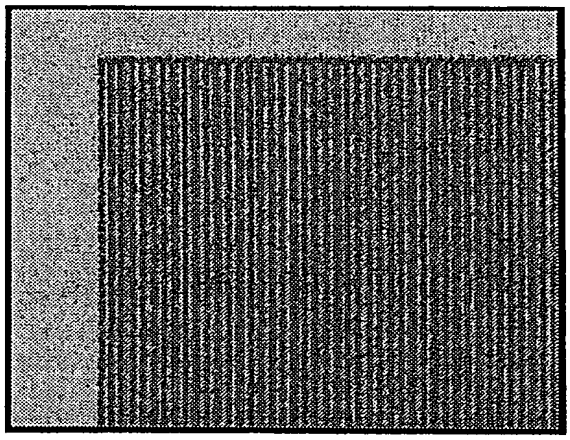
f(x, y)

FIG. 15B



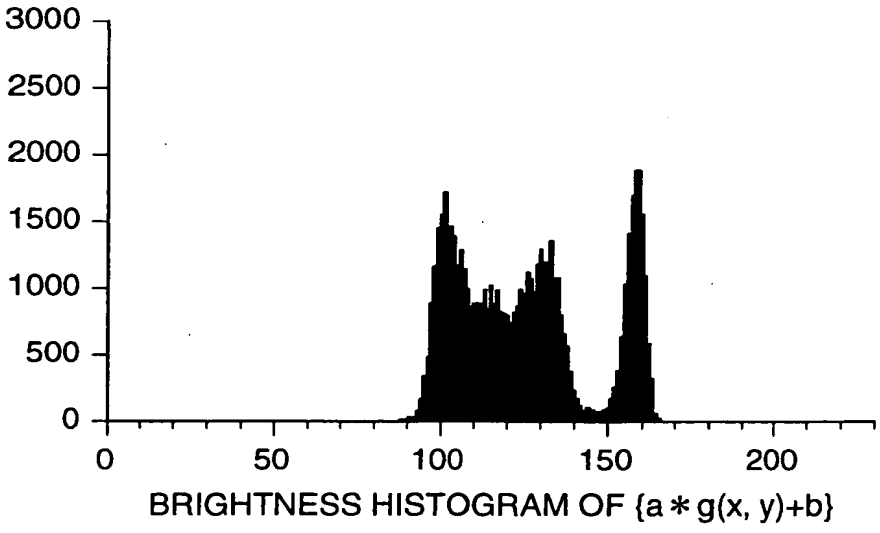
BRIGHTNESS HISTOGRAM OF f(x, y)

FIG. 16A



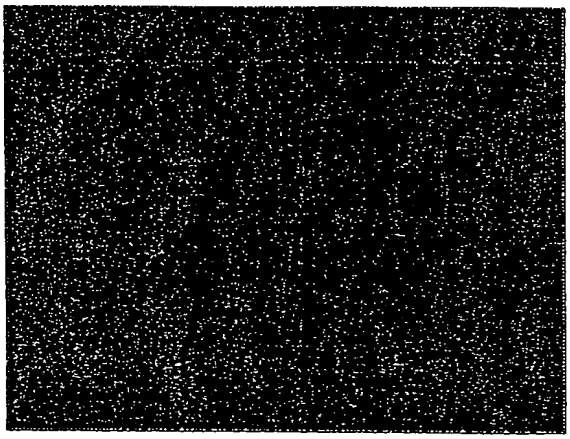
$a * g(x, y)+b$

FIG. 16B



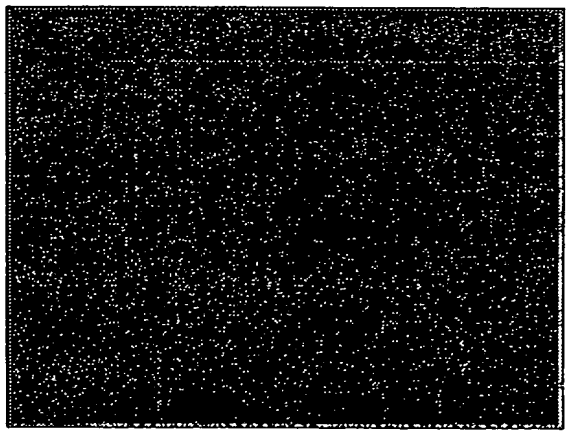
* a,b ARE ESTIMATED WITHIN LOCAL REGION OF IMAGE AT EACH POINT

FIG. 17A



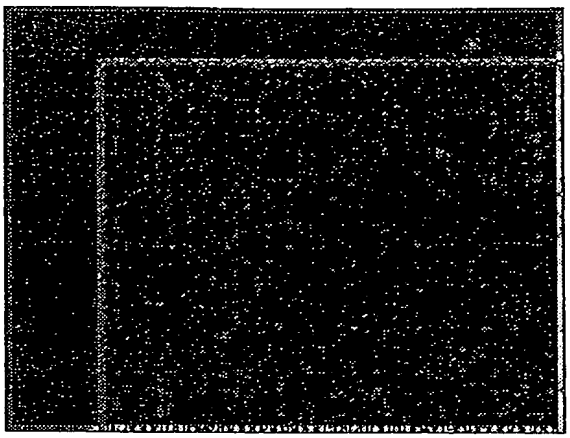
DIFFERENCE IMAGE 1 (3×3)

FIG. 17B



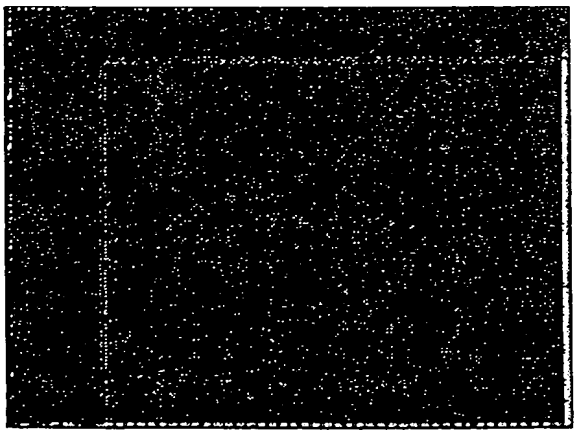
DIFFERENCE IMAGE 2 (5×5)

FIG. 18A



DIFFERENCE IMAGE 3 (7×7)

FIG. 18B



DIFFERENCE IMAGE 4 (7×7, WEIGHTED)

FIG. 19

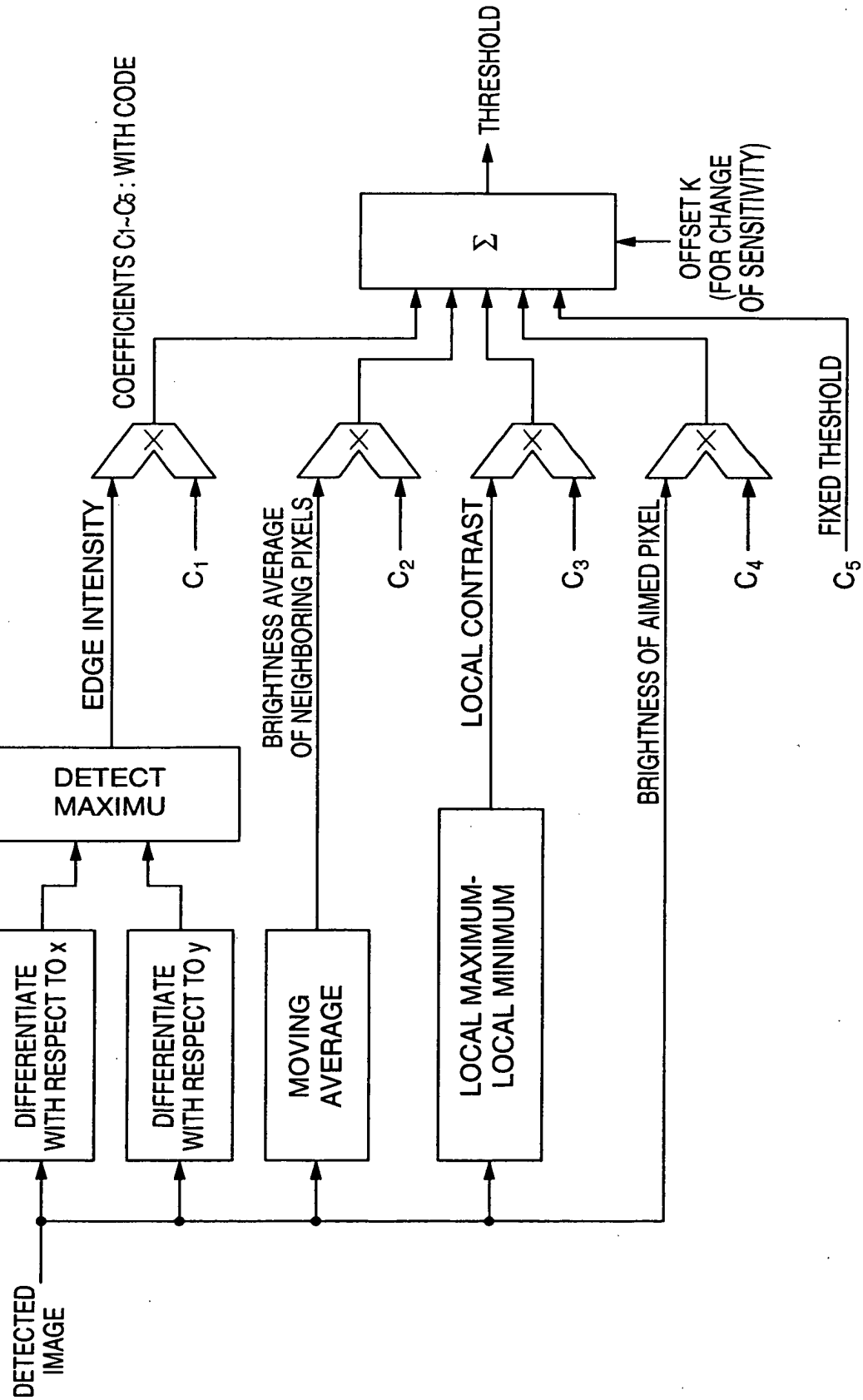


FIG. 20

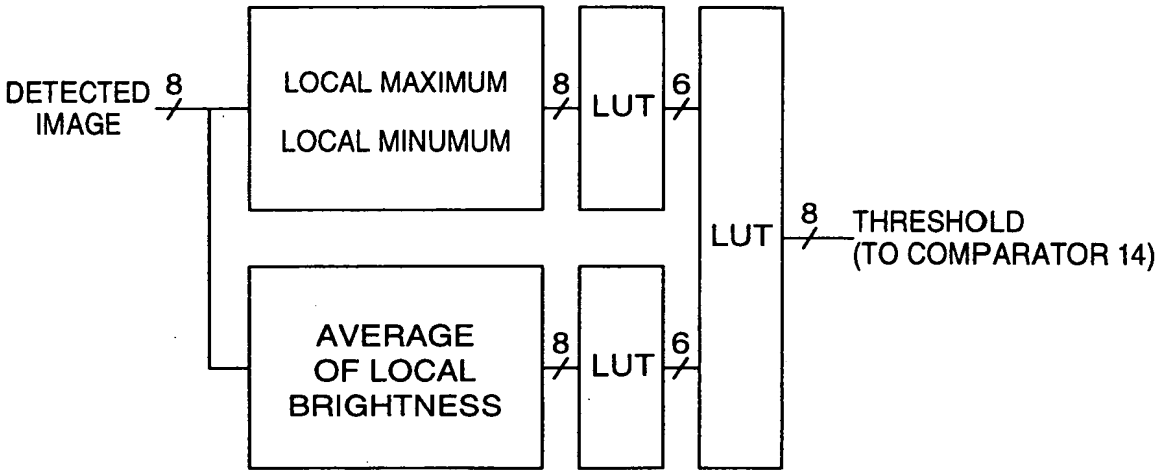
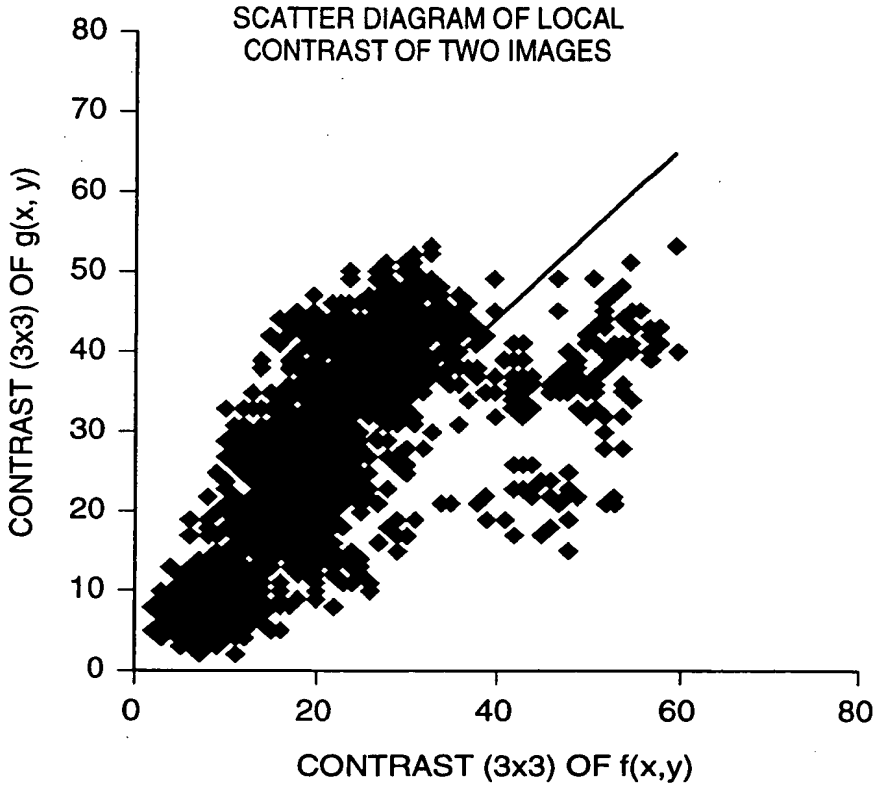


FIG. 21

1) AFTER ALIGNMENT WITH ACCURACY OF PIXEL UNIT

GRADIENT	INTERCEPT
1.038	2.336

Vr= 125.774
Ve= 59.653



VALUE OF Ve

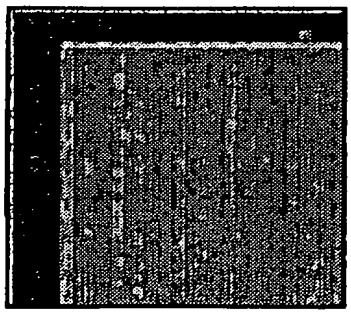
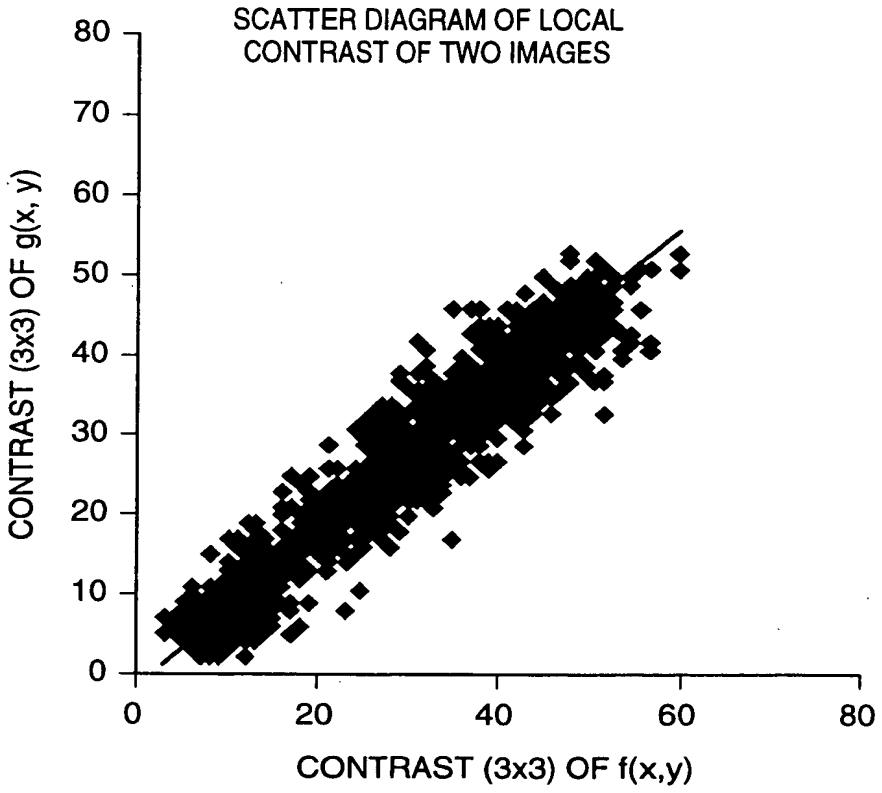


FIG. 22

2) AFTER MATCHING OF BRIGHTNESS

GRADIENT	INTERCEPT
0.958	−1.649

Vr= 175.852
Ve= 9.603



VALUE OF Ve

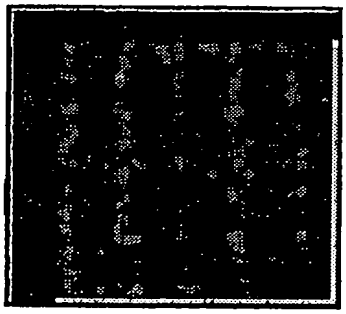
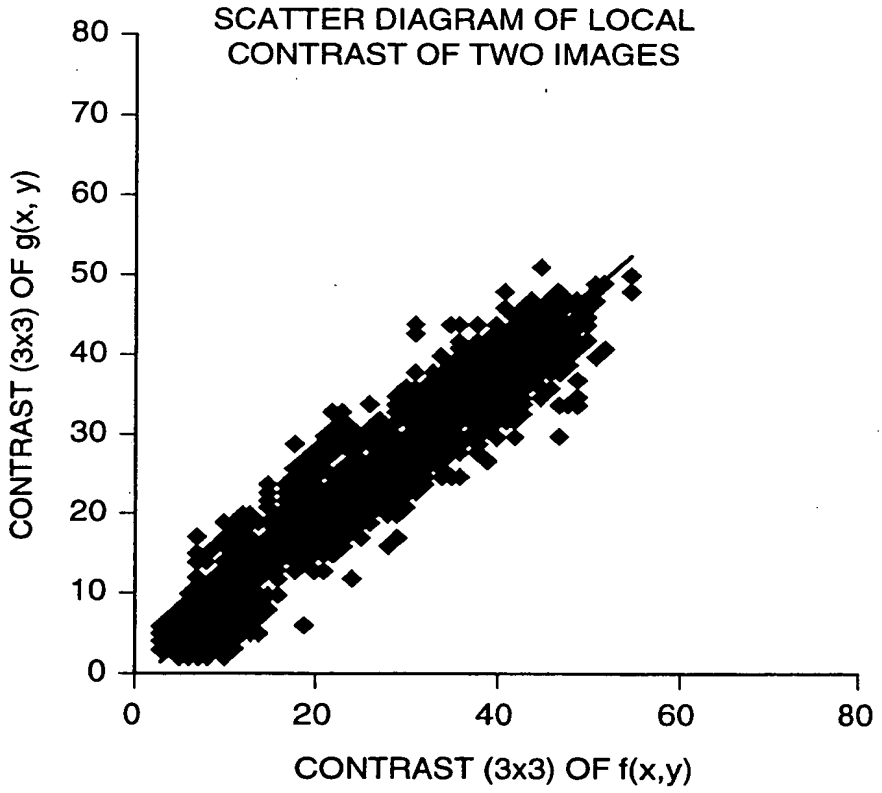


FIG. 23

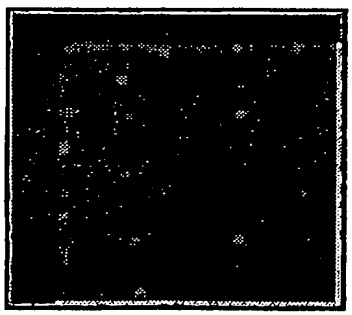
3) AFTER ALIGNMENT OF SUB-PIXEL

GRADIENT	INTERCEPT
0.981	−1.454

Vr= 168.393
Ve= 8.869



VALUE OF Ve



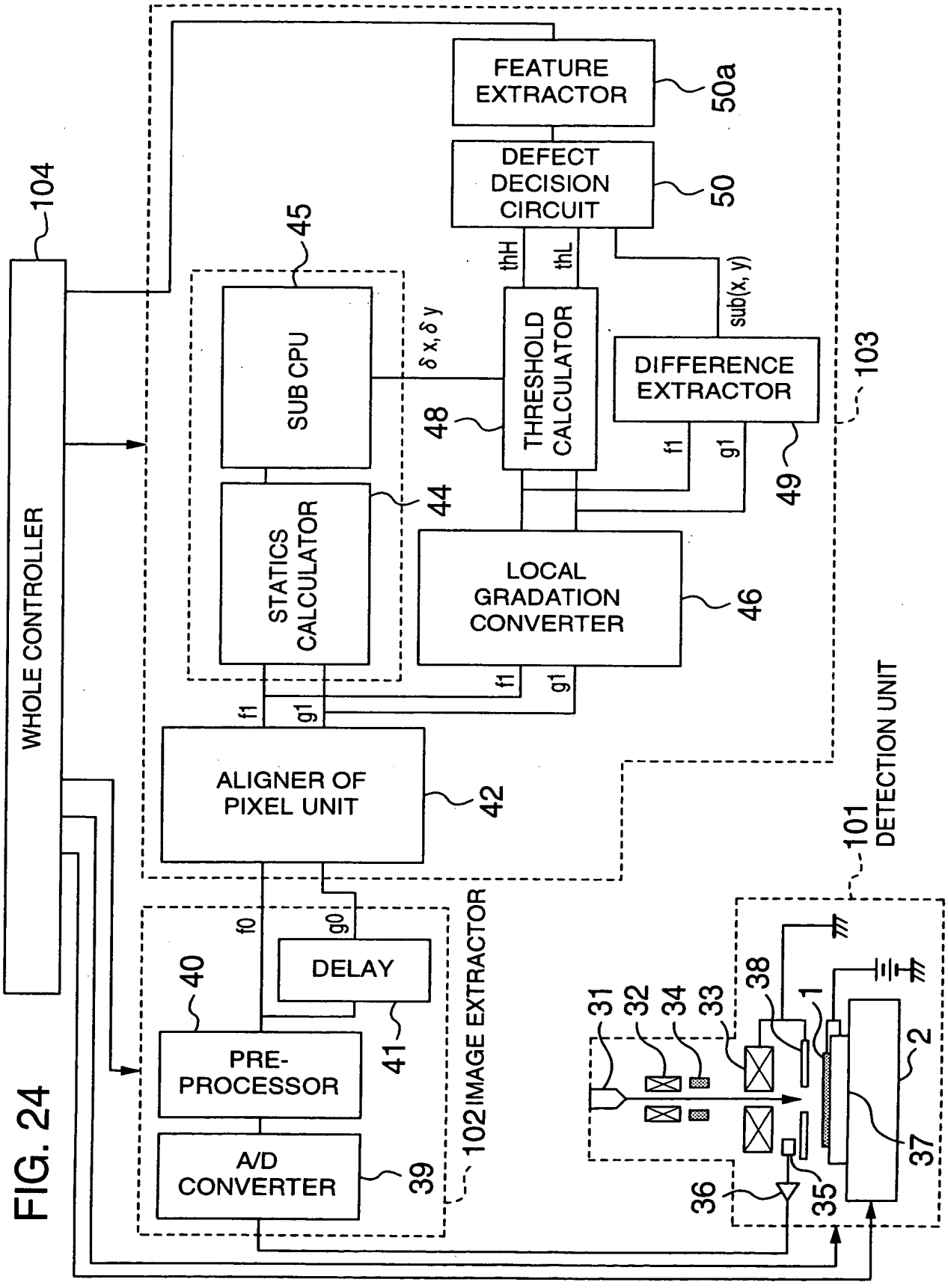


FIG. 24

FIG. 25

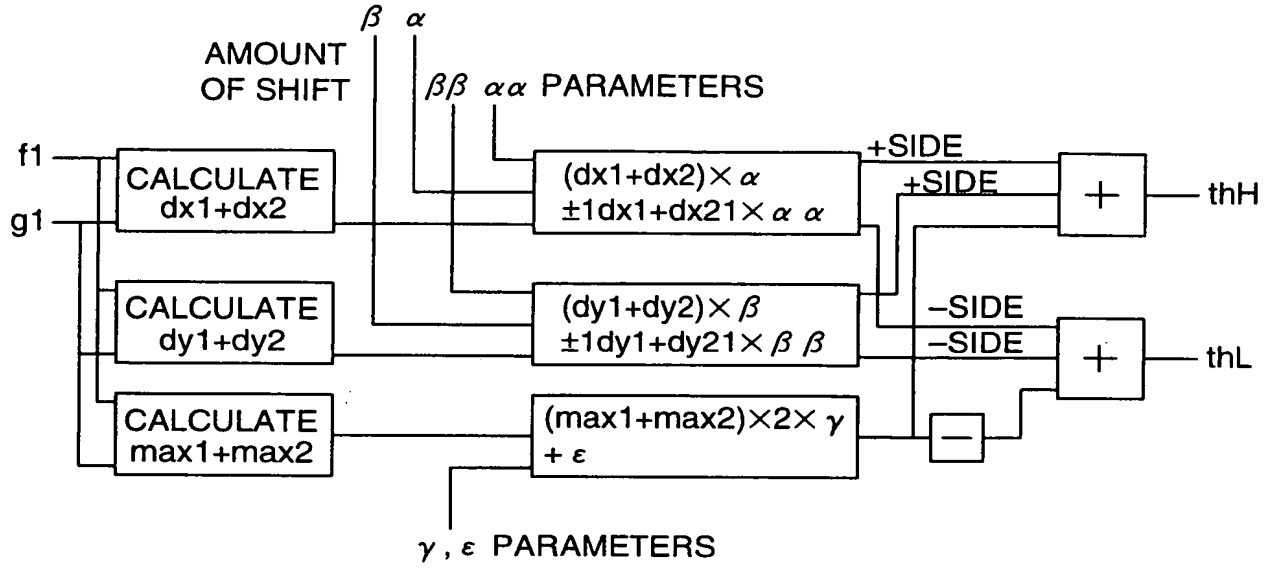


FIG. 26

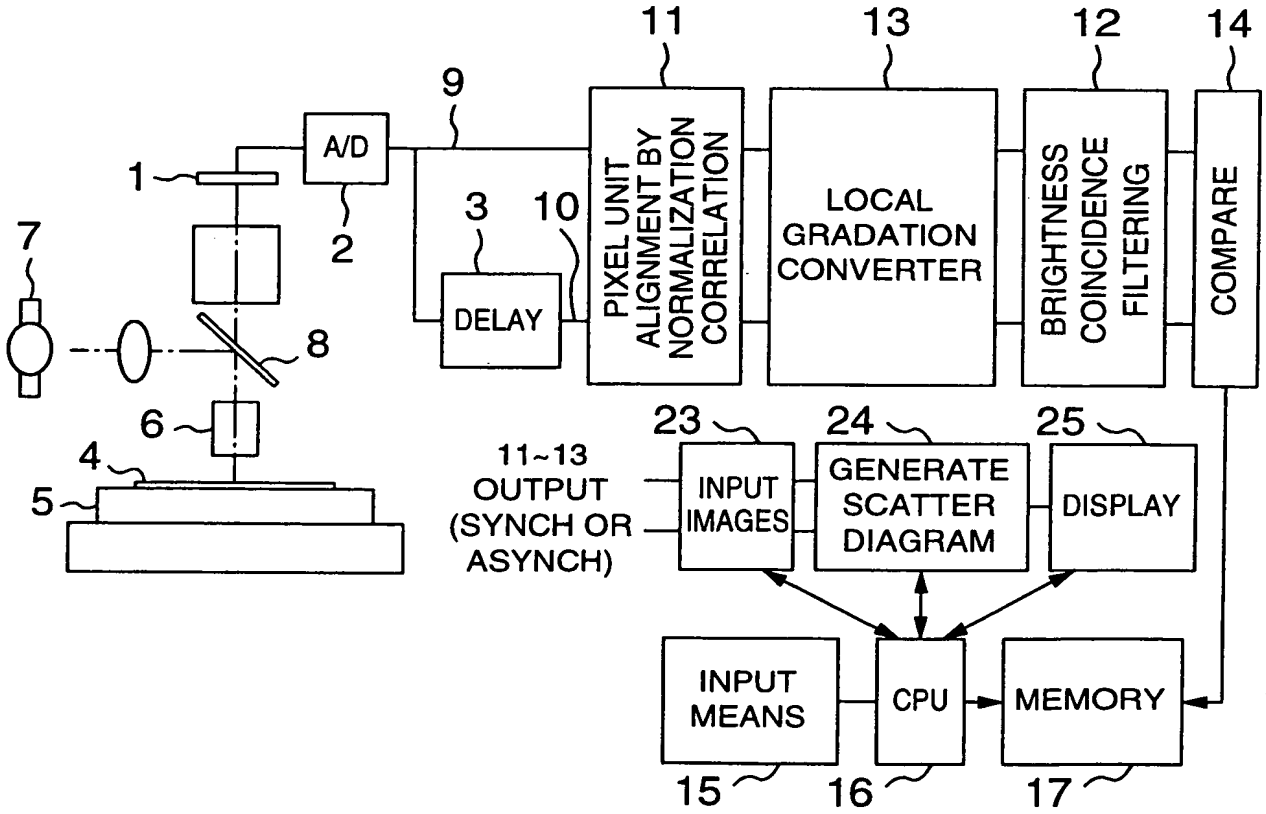


FIG. 27

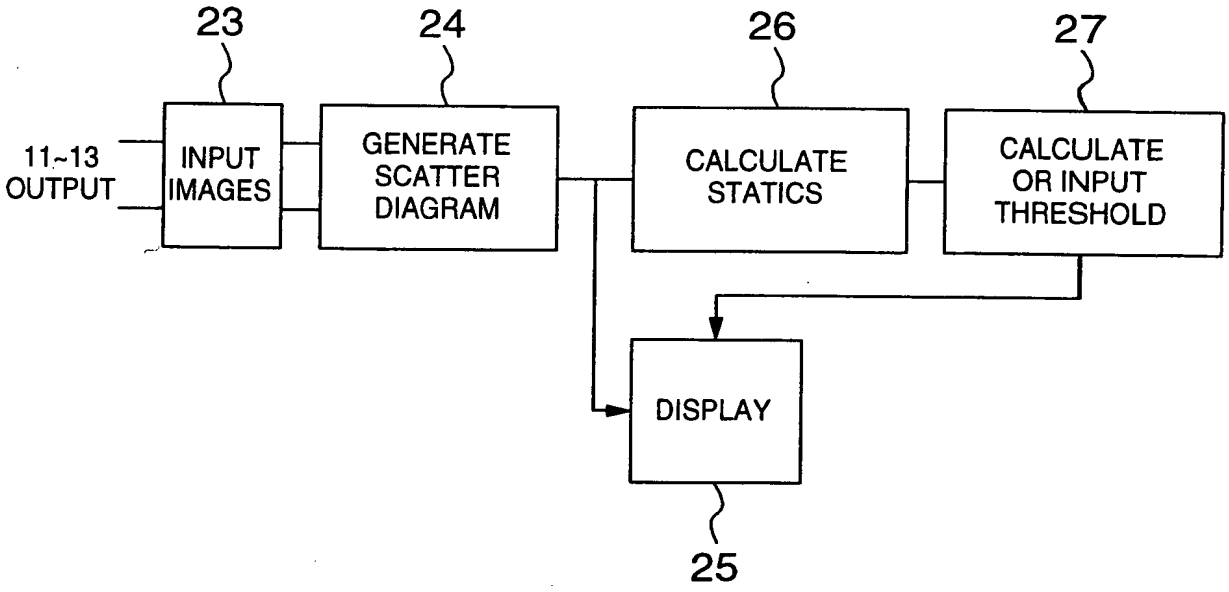
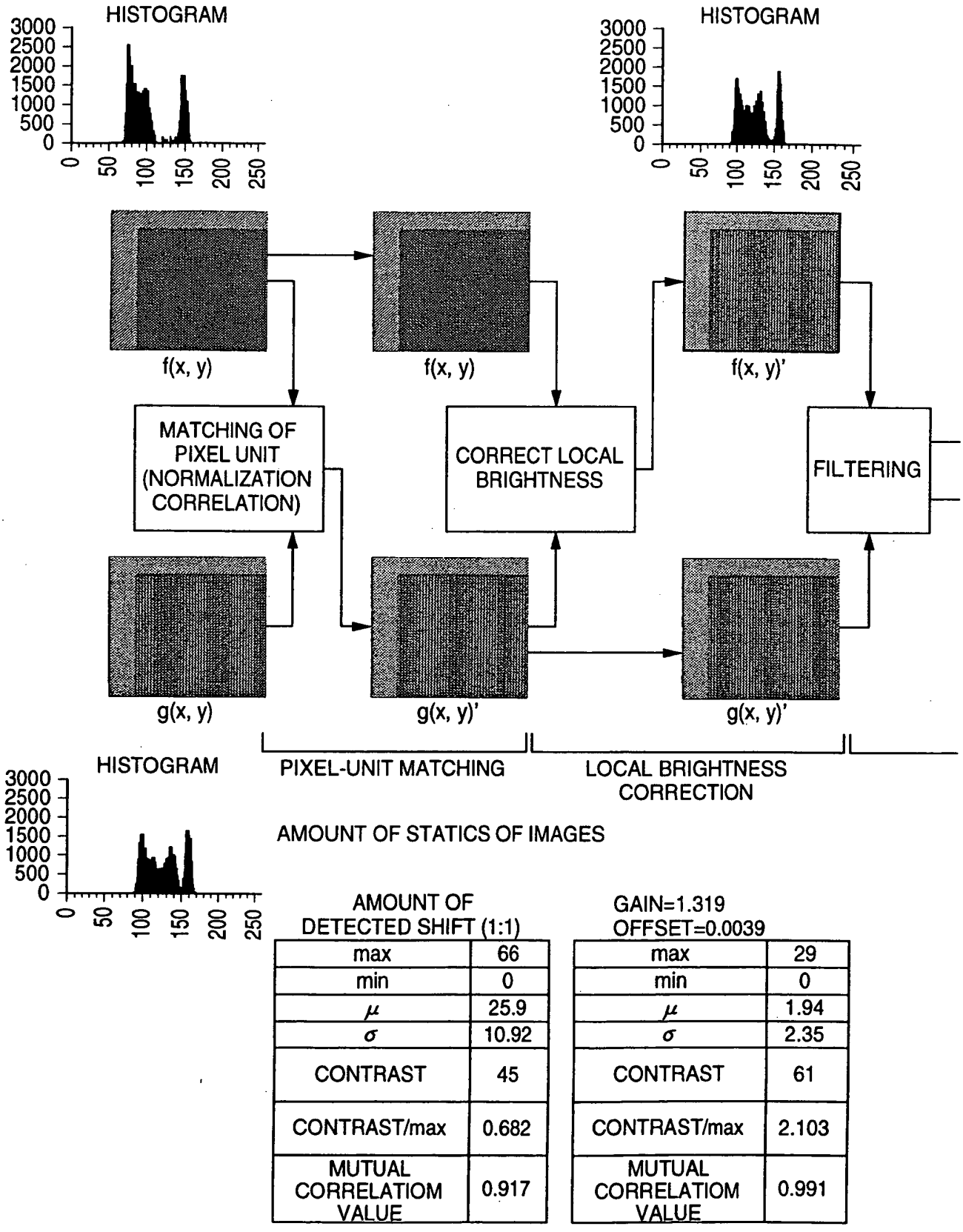


FIG. 28

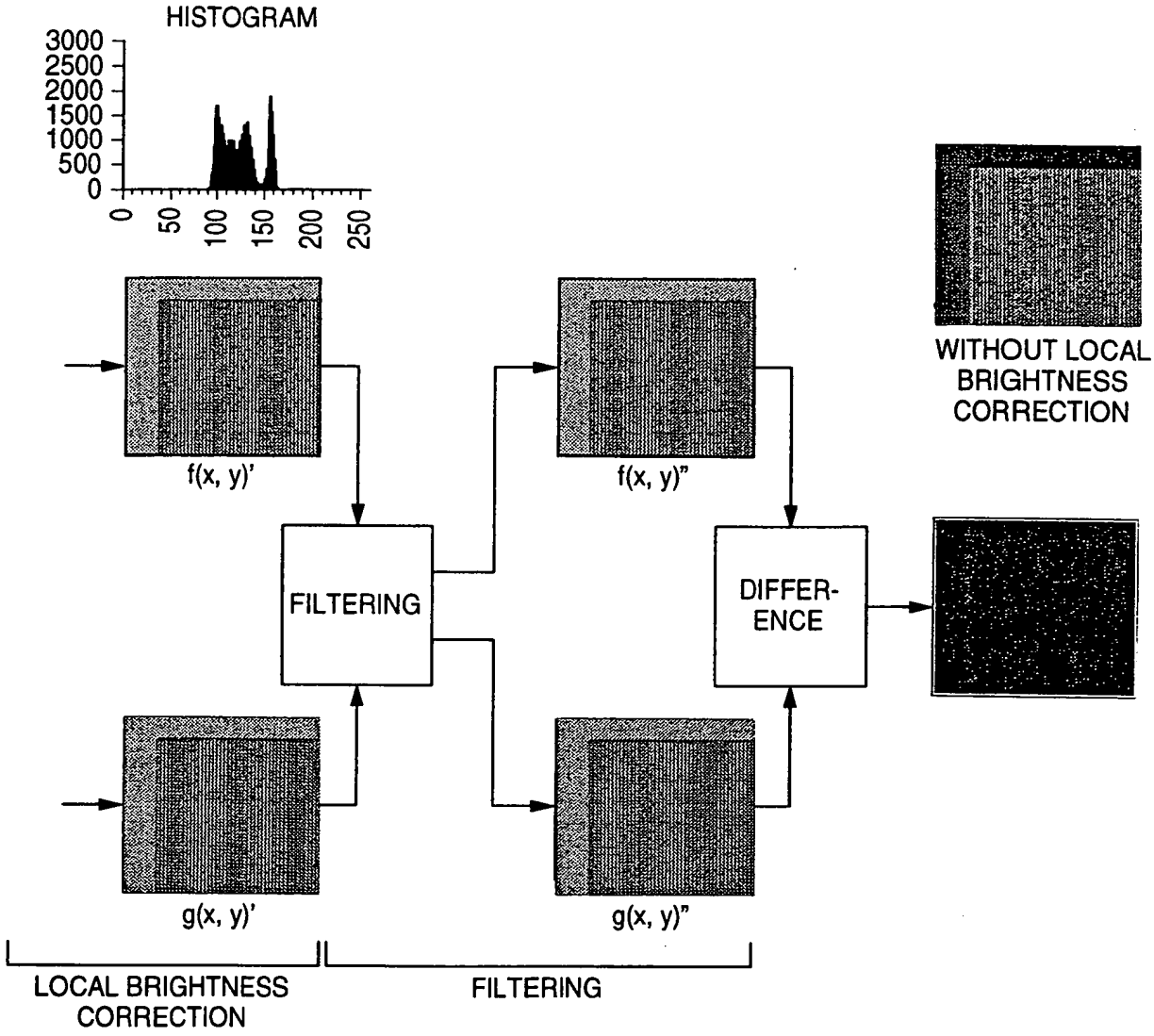


AMOUNT OF STATICS OF IMAGES

AMOUNT OF DETECTED SHIFT (1:1)	
max	66
min	0
μ	25.9
σ	10.92
CONTRAST	45
CONTRAST/max	0.682
MUTUAL CORRELATIOM VALUE	0.917

GAIN=1.319 OFFSET=0.0039	
max	29
min	0
μ	1.94
σ	2.35
CONTRAST	61
CONTRAST/max	2.103
MUTUAL CORRELATIOM VALUE	0.991

FIG. 29



GAIN=1.319
OFFSET=0.0039

max	29
min	0
μ	1.94
σ	2.35
CONTRAST	61
CONTRAST/max	2.103
MUTUAL CORRELATIOM VALUE	0.991

α =0.036(x)
β =0.106(y)

max	25
min	0
μ	1.92
σ	1.87
CONTRAST	57
CONTRAST/max	2.280
MUTUAL CORRELATIOM VALUE	0.993

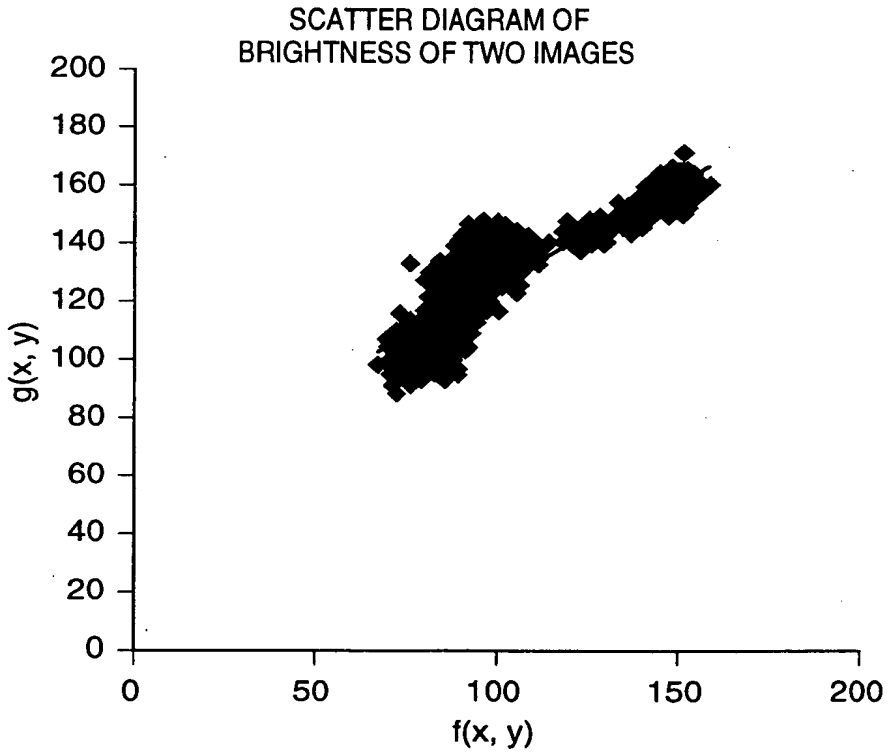
FIG. 30

SCATTER OF BRIGHTNESS OF TWO IMAGES AND AMOUNT OF STATICS Ve

1) AFTER ALIGNMENT OF PIXEL UNIT

GRADIENT	INTERCEPT
0.705	55.947

Vr= 447.4806
Ve= 40.02821



VALUE OF Ve

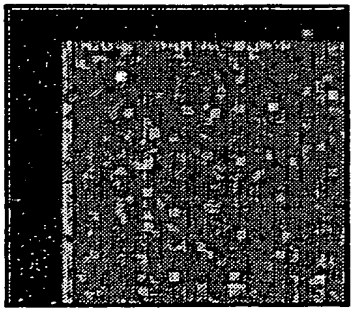
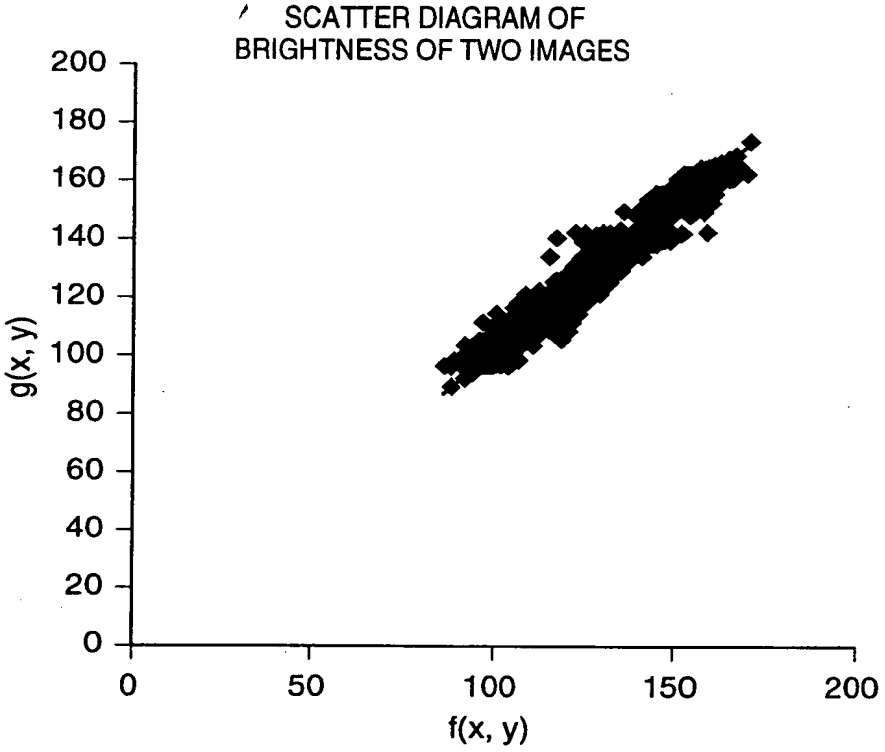


FIG. 31

2) AFTER BRIGHTNESS MATCHING

GRADIENT	INTERCEPT
0.986	2.567

Vr= 478.921
Ve= 8.598012



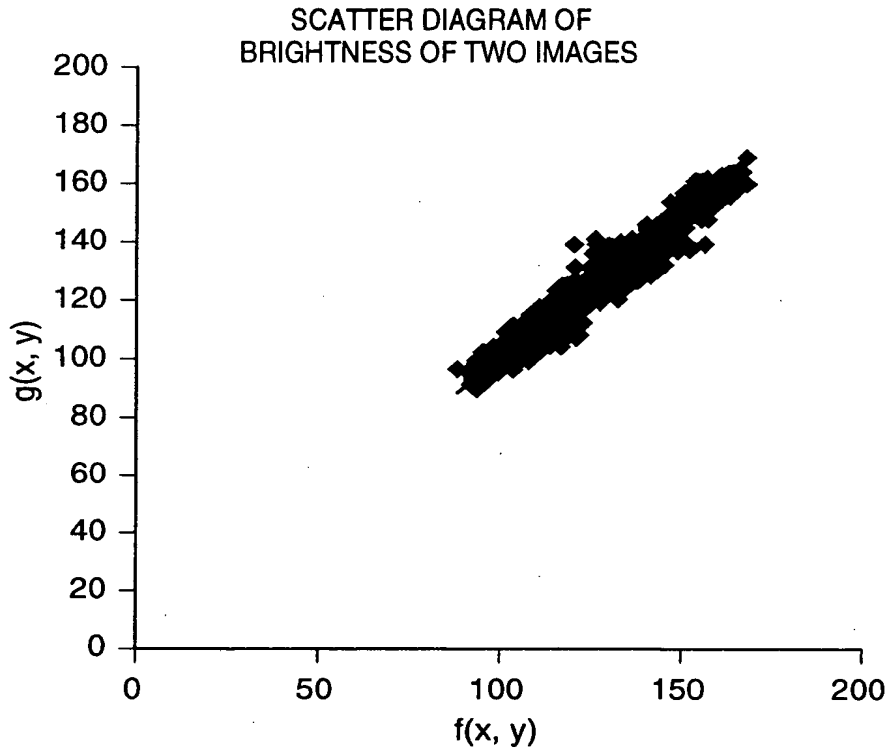
VALUE OF Ve

FIG. 32

3) AFTER FILTERING

GRADIENT	INTERCEPT
0.991	1.568

Vr= 473.2729
Ve= 7.477604



VALUE OF Ve

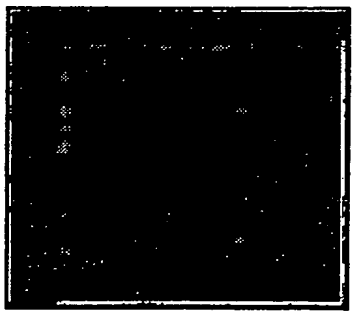


FIG. 33

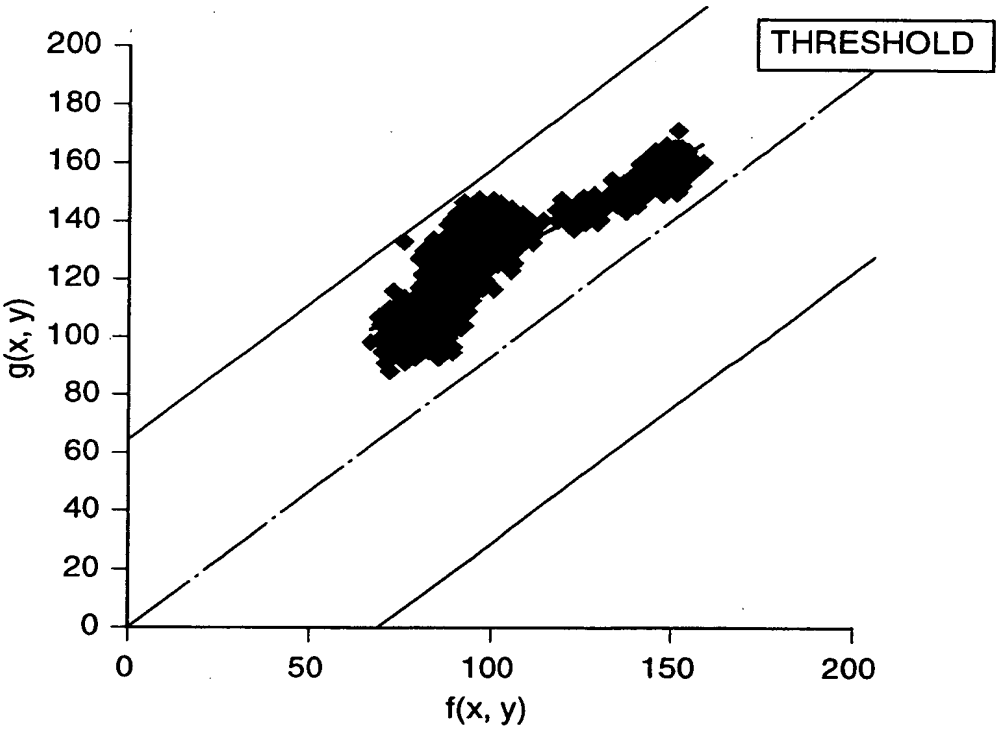


FIG. 34

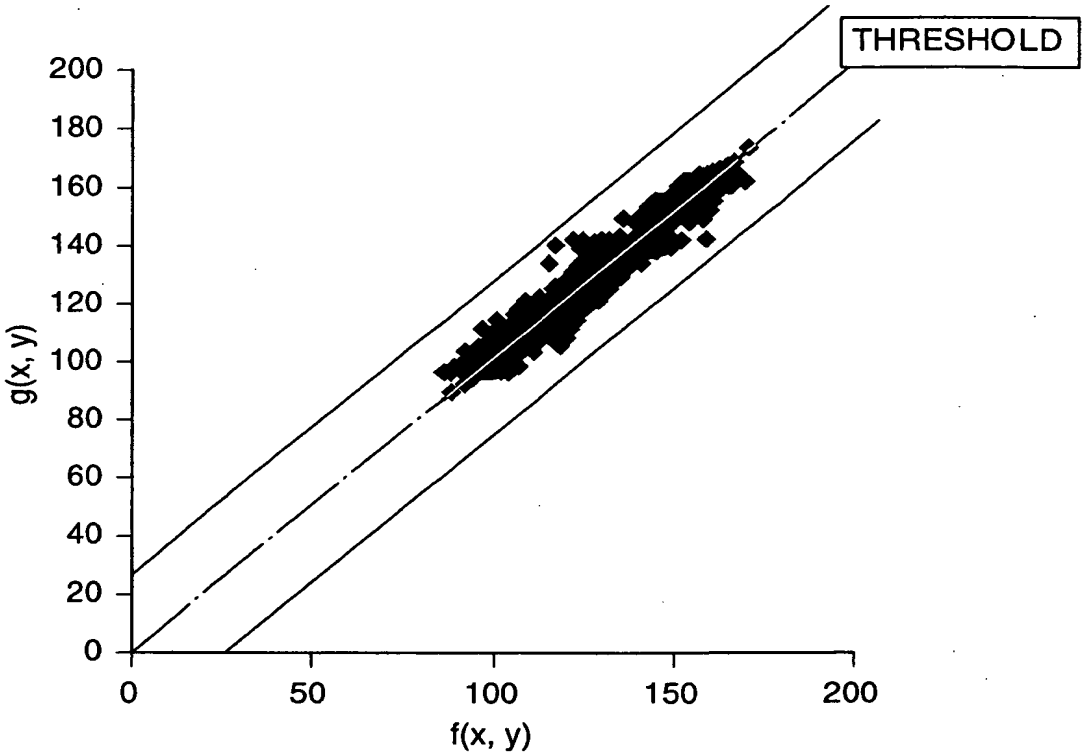


FIG. 35

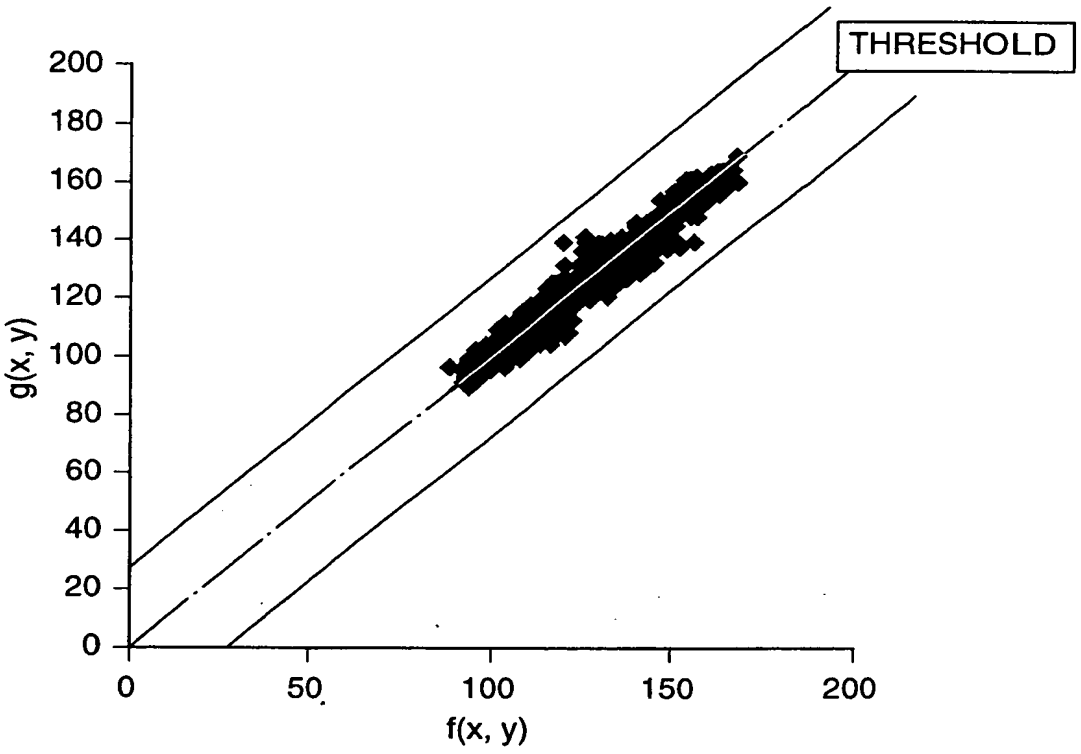


FIG. 36

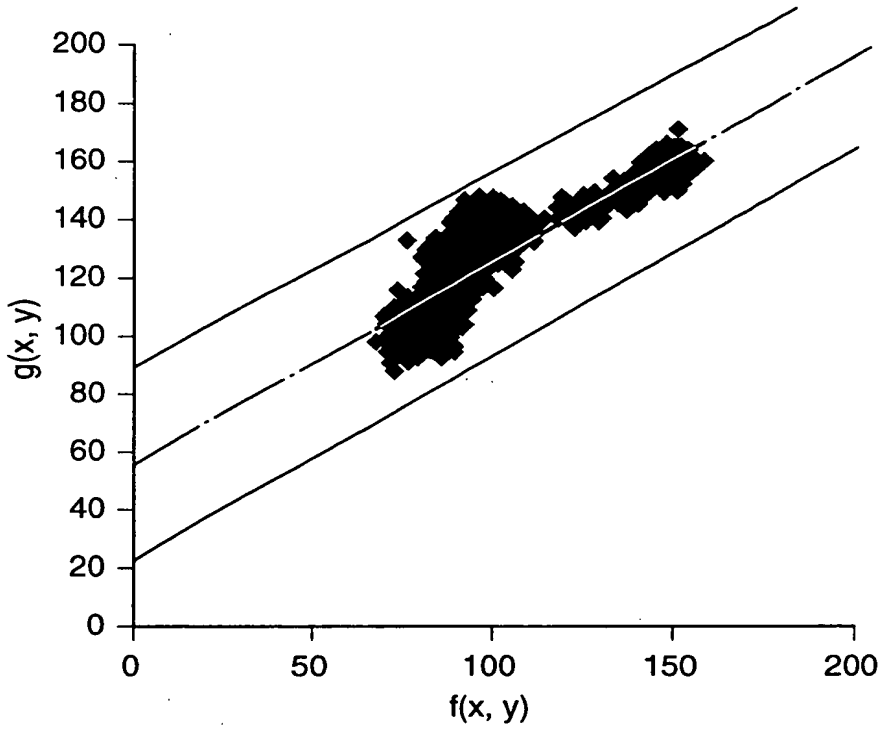


FIG. 37

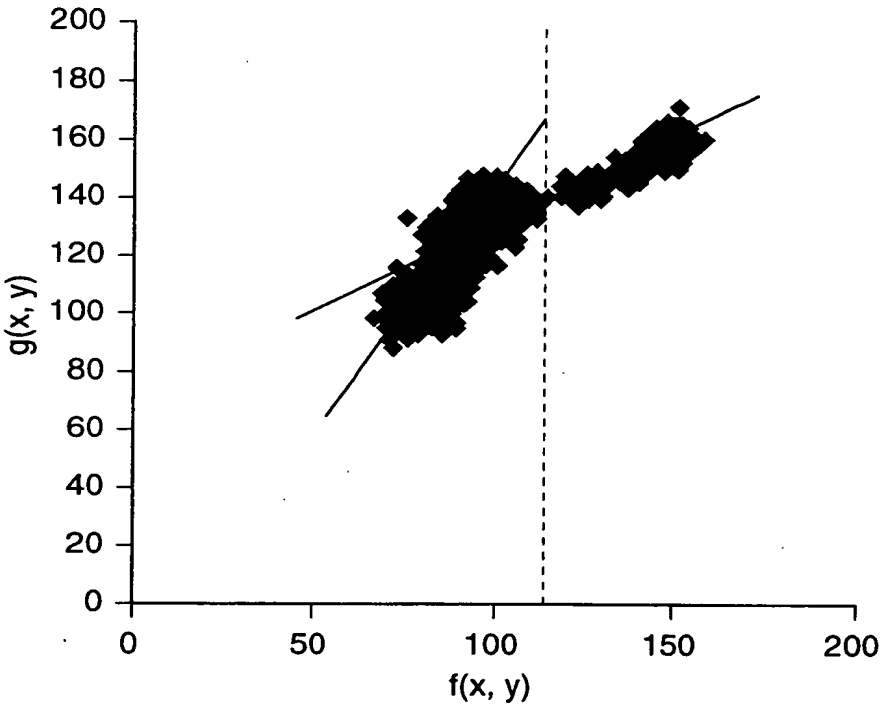


FIG. 38

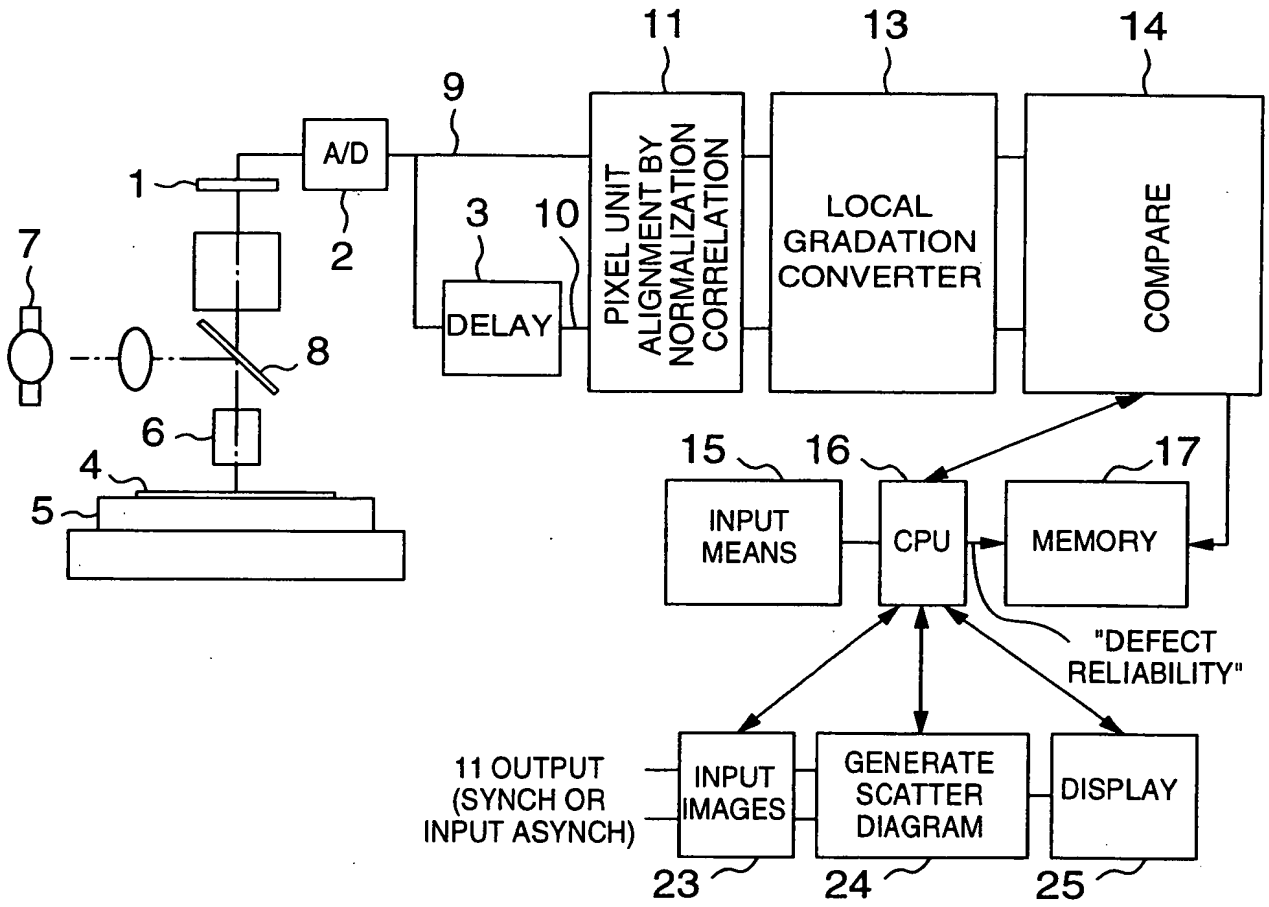


FIG. 41

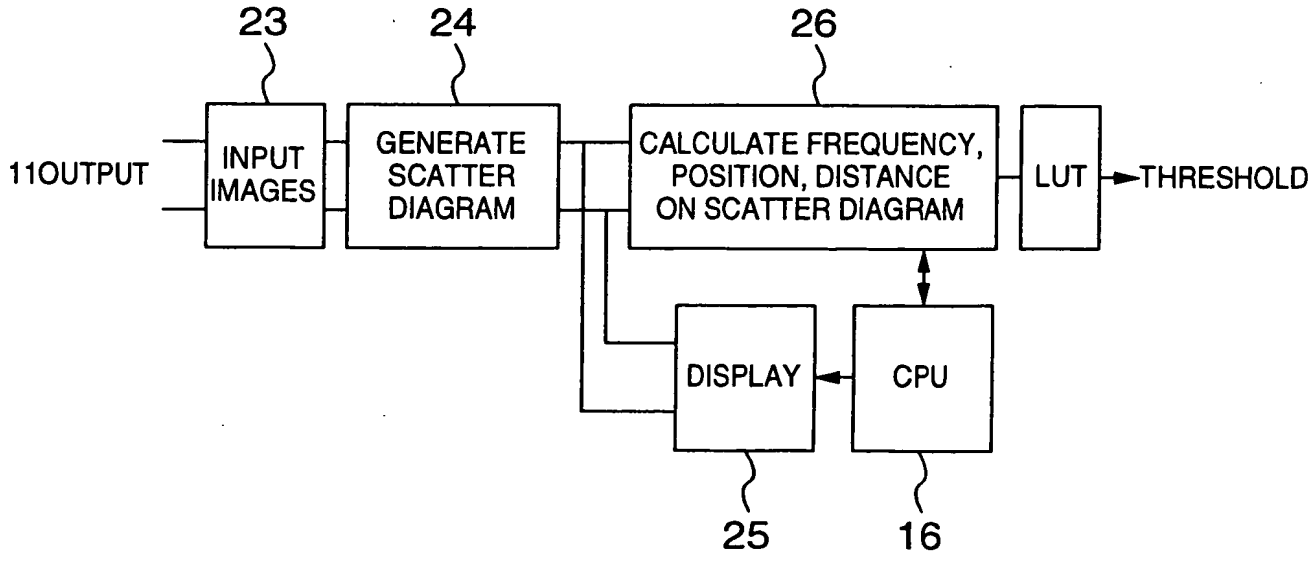
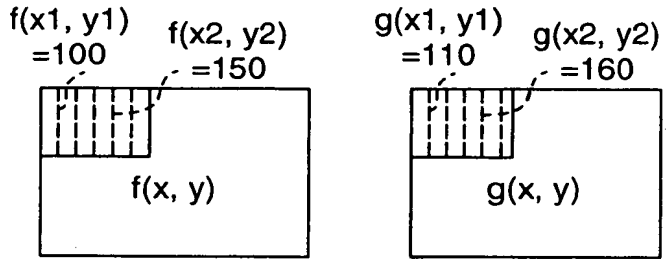
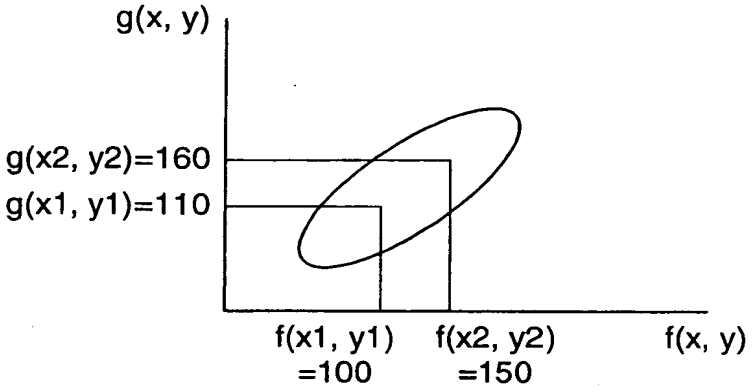
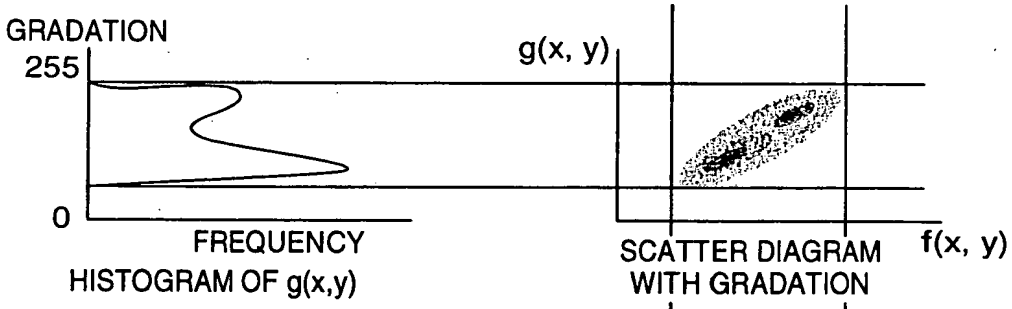
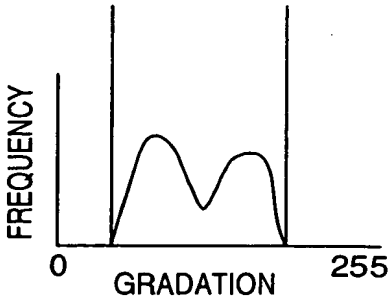


FIG. 39

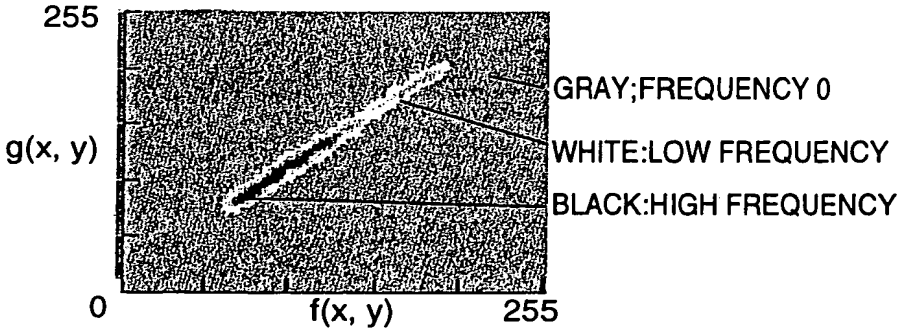






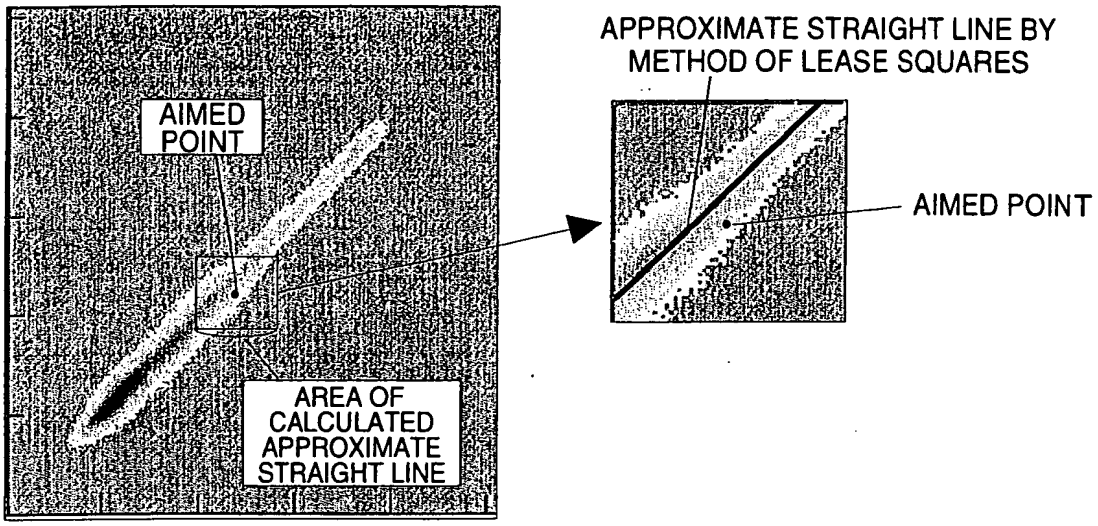


HISTOGRAM OF f(x,y)



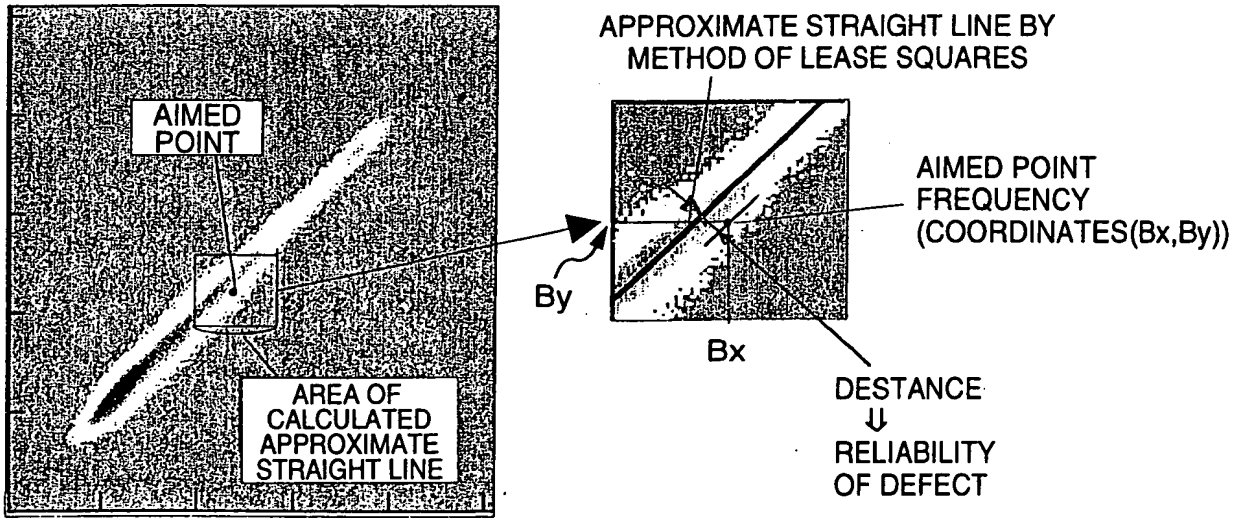
EXAMPLE OF SCATTER DIAGRAM

FIG. 40A



- ESTIMATE STRAIGHT LINE IN AREA WITH CENTER OF AIMED POINT ON SCATTER DIAGRAM, AND SELECT THE GAIN AND OFFSET AS CORRECTION COEFFICIENTS
- MAKE AREA SIZE VARIABLE ACCORDING TO FREQUENCY OF SCATTER DIAGRAM

FIG. 40B



- ESTIMATE STRAIGHT LINE IN AREA WITH CENTER OF AIMED POINT ON SCATTER DIAGRAM, AND SELECT THE GAIN AND OFFSET AS CORRECTION COEFFICIENTS
- MAKE AREA SIZE VARIABLE ACCORDING TO FREQUENCY OF SCATTER DIAGRAM

FIG. 42

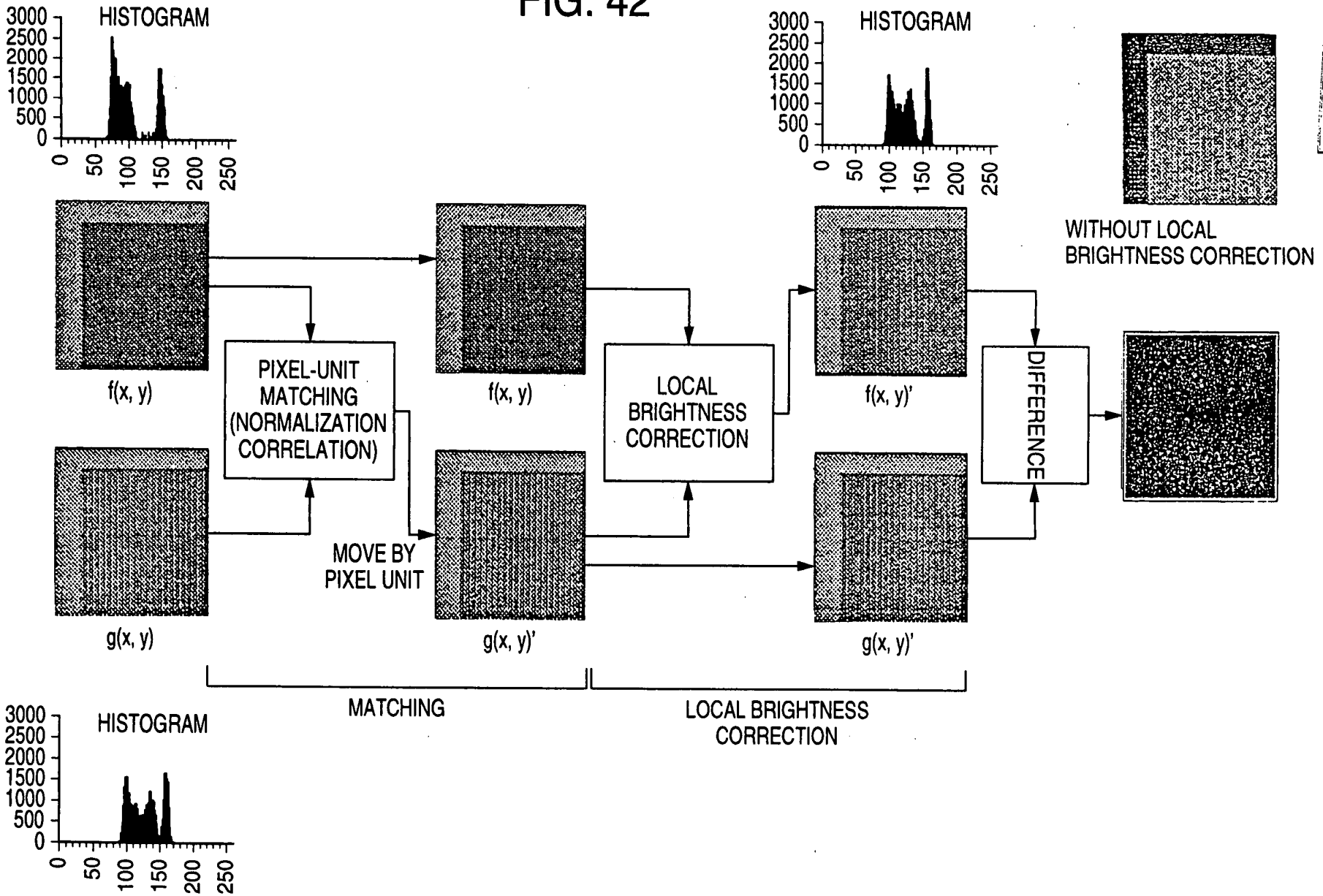


FIG. 43A

1) AFTER ALIGNMENT WITH ACCURACY OF PIXEL UNIT

GRADIENT	INTERCEPT
0.705	55.947

Vr= 447.4806
Ve= 40.02821

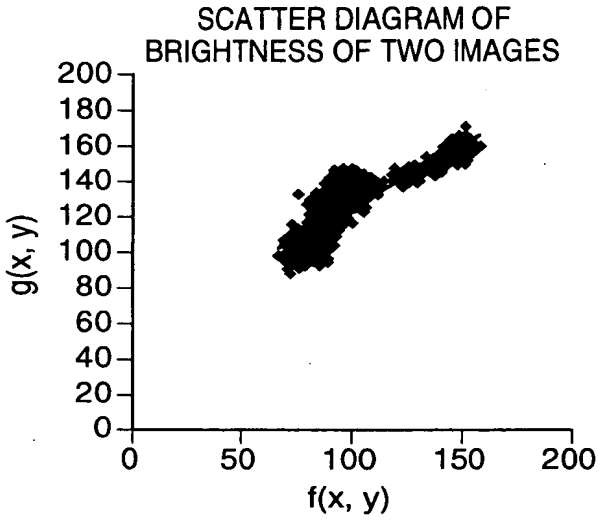


FIG. 43B

2) AFTER BRIGHTNESS MATCHING

GRADIENT	INTERCEPT
0.986	2.567

Vr= 478.921
Ve= 8.598012

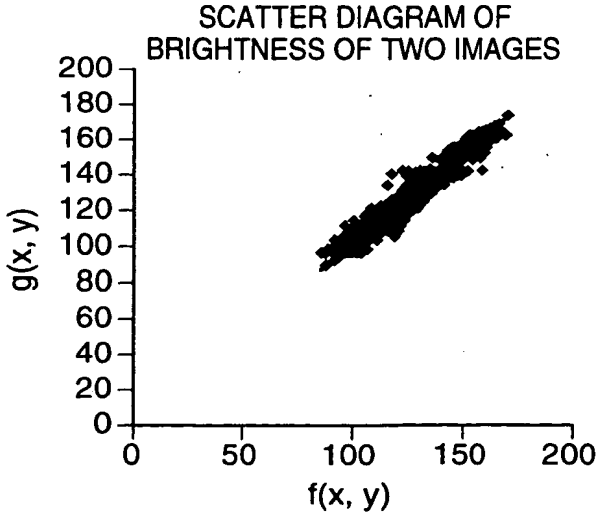


FIG. 44A

DEFECT NUMBER	DEFECT COORDINATES	DEFECT AREA	DEFECT LENGTH	DEFECT BRIGHTNESS DIFFERENCE	DEFECT RELIABILIRY (FREQUENCY INFORMATION)
1	(100.10, 202.20)	4.54	(2.2, 1.6)	14	100
2	(120.75, 232.72)	10.2	(2.9, 4.2)	20	250
3	.....				

FIG. 44B

DEFECT NUMBER	DEFECT COORDINATES	DEFECT AREA	DEFECT LENGTH	DEFECT BRIGHTNESS DIFFERENCE	DEFECT RELIABILIRY (DISTANCE INFORMATION)
1	(100.10, 202.20)	4.54	(2.2, 1.5)	14	25
2	(120.75, 232.72)	10.2	(2.9, 4.2)	20	12
3	.....				

FIG. 44C

DEFECT NUMBER	DEFECT COORDINATES	DEFECT AREA	DEFECT LENGTH	DEFECT BRIGHTNESS DIFFERENCE	DEFECT RELIABILIRY (POSITION INFORMATION)
1	(100.10, 202.20)	4.54	(2.2, 1.5)	14	(100, 200)
2	(120.75, 232.72)	10.2	(2.9, 4.2)	20	(250, 200)
3	.....				

FIG. 45

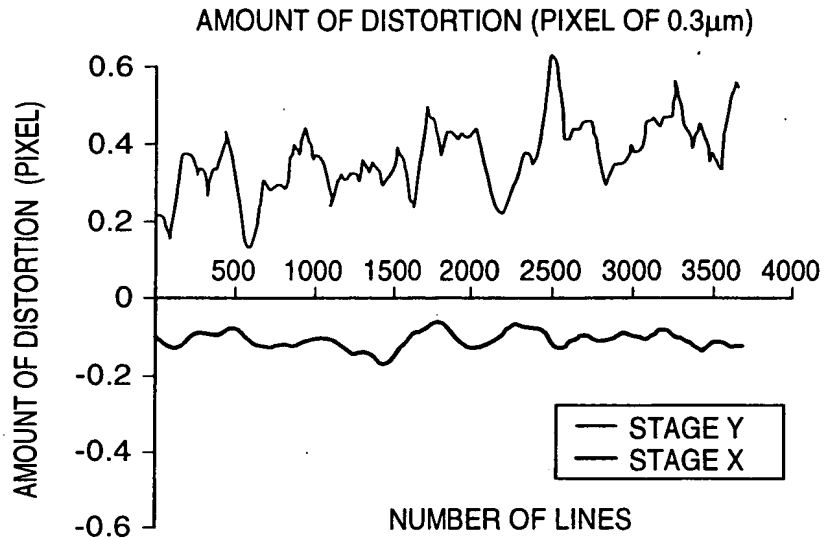


FIG. 46